VSB – TECHNICAL UNIVERSITY OF OSTRAVA
FACULTY OF ECONOMICS

DEPARTMENT OF EUROPEAN INTEGRATION

Implikace finančního rozvoje a makroobezřetnostní politiky pro ekonomický růst: Evropský panel zemí
Implications of Financial Development and Macroprudential Policy for Economic Growth: A European Panel of Countries

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Ostrava 2020

VŠB - Technical University of Ostrava
Faculty of Economics
Department of European Integration

Diploma Thesis Assignment

Student: **Ngoc Anh Ngo, BA**

Study Programme: N6202 Economic Policy and Administration

Study Branch: 6210T004 European Integration

Title: Implications of Financial Development and Macroprudential Policy for Economic Growth: A European Panel of Countries
Implikace finančního rozvoje a makroobezřetnostní politiky pro ekonomický růst: Evropský panel zemí

The thesis language: English

Description:

1. Introduction
2. Theoretical framework and literature review of the analysed phenomena
3. Data and stylised facts of analysed countries
4. Analysis of interactions between the phenomena in the panel of countries
5. Conclusion
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List of Abbreviations
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Annexes

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Extent and terms of a thesis are specified in directions for its elaboration that are opened to the public on the web sites of the faculty.

Supervisor: **Ing. Martin Hodula, Ph.D.**

Date of issue: 22.11.2019

Date of submission: 24.04.2020

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I hereby declare that I have elaborated the entire thesis including annexes myself.

Ostrava dated 28th April 2020 .....

Ngọc Ánh Ngô, BA

First, I would like to thank my thesis supervisor, Ing. Martin Hodula, Ph.D. Without his support in every step throughout the process, this thesis would have never been accomplished. He steered me in the right direction whenever I needed it. Thank you for all your time, insightful comments and patience.

Second, I wish to express my endless thanks to my parents, sister and extended family who have sacrificed a lot for me while still offering unfailing and continuous encouragement. You have shown me that patience is the mother of success (kiên nhẫn là mẹ thành công). Cám ơn rất nhiều!

Third, I am grateful to my friends who have supported me along the way and have been helping me through all hardships and breakdowns with their unconditional moral support and kindness. Thank you all!

Lastly, I would like to thank VSB-Technical University of Ostrava for providing financial support for my research from SGS projects no. 2019/119 and 2020/110.

Contents

1 Introduction

Financial development is an important condition for sustainable growth. Improvements in the key functions of the financial sector promote economic growth through capital accumulation and technological progress. Furthermore, they foster productivity, mobilise savings and investment and broaden access to finance in the population. However, the finance-growth relationship is much more complex and deserves further exploration, because the growth based on financial development may be excessive and can endanger an economy, resulting in an economic crisis that would take its tolls on everyone.

The Global Financial Crisis in 2008 shed the light on possible causes of risks' build-ups which increase the probability and severity of crises and emphasized the need to develop macroeconomic models to study the interactions between financial system and real economy. As a response, multiple policies have been put forward by academics, central banks, regulators and other policy makers, aiming at preventing the systemic risk build-ups and thus reducing the likelihood and impacts of crises on the financial sector and the economy as a whole, because stable economic and financial environments are necessary conditions for growth.

The importance of a sound regulatory framework grows as the financial development progresses. One of the newly emphasized policies is the macroprudential policy which aims at promoting financial stability. Macroprudential policy measures avert the emergence of financial imbalances and build resilience in the financial sector in good times, so the financial intermediation and lending can support the economy in bad times. As a relatively new policy, it attracts the attention of researchers who study its use, effectiveness and interactions with other existing policies to identify its impacts on financial sector developments and economic growth.

This thesis focuses on separate and joint interactions between financial development, macroprudential policy and economic growth in a monetary union. The main aim is to identify implications of financial development and macroprudential policy for economic growth in the selected panel of European Union countries from both theoretical and empirical perspective. The theoretical perspective provides a framework of existing literature and approaches to the topic while the empirical perspective examines the implications in different model specifications, based on the theoretical framework.

The diploma thesis is divided in three thematic chapters which are complemented by an introduction and a conclusion. First thematic chapter defines key terms of the thesis and thus provide a theoretical framework for further research. After that, a review of relevant literature focusing on interactions between analysed phenomena (financial development-economic growth, financial development-macroprudential policy, macroprudential policy-economic growth, macroprudential policy-other public policies) is conducted to provide an overview of previous studies and approaches to the phenomena.

Second thematic chapter contains data and stylised facts on the countries in the panel. First part of the chapter analyses financial and banking sectors in the panel of countries, focusing on its size and role in each economy. Second part focuses on macroprudential policy – how it is approached on different levels, its legal and institutional framework and the appropriate instruments. Third part is about monetary policy as one of the key common features in the panel of countries. Fourth part combines outcomes from the two previous parts and explains institutional frameworks of macroprudential and monetary policy in the countries. Last part of this chapter is about definition and analysis of available data for analysed phenomena.

Third thematic chapter is an empirical analysis of interactions between financial development, economic growth and macroprudential policy. First part of the chapter provides a theoretical framework, specifications of the models and analysis of input data. In the second part, results for baseline model (implications of financial development for economic growth) is presented. In the third part, macroprudential policy is added to the extended model specification together with sub-dimensions of financial development. Fourth part includes robustness checks for the above-mentioned model specifications and the last part compares the results to the economic theory and provides some policy implications on conduct of macroprudential policy.

The theoretical framework presented in the diploma thesis is based on professional books, seminal studies published in internationally recognised journals and official publications of relevant institutions. The data used in the empirical analysis are taken from the Organisation for Economic Cooperation and Development, the World Bank, the European Commission and Vienna Institute of Economics and further processed in Stata.

2 Theoretical framework and literature review of the analysed phenomena

This chapter aims at defining the key phenomena related to this diploma thesis. Every phenomenon is provided with a definition, key aspects and further elaboration based on review of existing theoretical frameworks and models. After that, interaction between each of the phenomena is analysed by review of relevant empirical studies.

2.1 Financial development: definition and measurement

2.1.1 Definition of financial development

Financial development is defined by Levine (2005) as improvements in the quality of key functions of the financial sector:

- production of ex ante information about possible investments,
- monitoring of investments and implementation of corporate governance,
- trading, diversification and management of risk,
- mobilisation and pooling of savings,
- exchange of goods and services.

At the conceptual level, financial development occurs when in the financial sector, instruments, markets and intermediaries mitigate (not necessarily eliminate) the effects of imperfect information, limited enforcement of contracts and transaction costs (Čihák et al., 2012).

Financial sector is divided in six parts by Cecchetti and Schoenholtz (2011):

- money which is used to pay for purchases and storage of wealth,
- financial instruments (e. g. stocks, mortgages and insurance policies) which are used for transfer of resources from savers to investors and for transfer of risk to those who are best equipped to bear it,
- financial markets (e. g. stock exchange) which allow us to buy and sell financial instruments,
- financial institutions which provide access to the financial markets and collection of information about prospective borrowers to ensure their creditworthiness,
- regulatory agencies responsible for making sure that financial sector elements (including its instruments, markets and institutions) operate in a safe and reliable way,
- central banks which monitor and stabilise the economy.

The structure of financial sector varies across countries and changes as countries develop (Boyd and Smith, 1986). According to King and Levine (1993), it is affected by:

- technological improvements which lower transaction costs and affect financial arrangements (Merton, 1992);
- monetary and fiscal policies have an impact on taxation of financial intermediaries and the provision of financial services (Bencivenga et al. 1995; Roubini and Sala-i-Martín 1995);
- legal system which determine financial systems (La Porta et al., 1996);
- political changes and national institutional arrangements which critically influence financial development (Haber, 1991).

2.1.2 Measures of financial development

A good measurement is crucial to assess the development in the financial sector and to understand the impact of this development on economic growth. As this phenomenon has several dimensions, indicators which are used for measuring the financial development are rough approximations and cannot capture all of its aspects. Empirical studies are usually based on proxies such as liquid liabilities to GDP, bank credit to the sum of bank credit and domestic assets of the central bank, domestic credit to GDP, credit allocated to private enterprises to GDP, stock market capitalisation ratio, stock market activity, stock market turnover ratio, overall stock market development, share of resources devoted to the financial system and deposit money bank assets to GDP. However, these capture separate aspects of financial development while this thesis focuses on aggregated financial development and aggregated development of two key aspects – institutions and markets.

Čihák et al. (2012) introduce the Global Financial Development Database which contains characteristics of financial system for 214 economies. In the database, there are annual data from 1960 to 2017 for 109 indicators, capturing various aspects of financial institutions and markets. The database includes measures of depth, access, efficiency and stability both for financial institutions (banks and other financial intermediaries), and financial markets (e. g. stock markets and bond markets). Svirydzenka (2016) follows the principles set by Čihák et al. (2012) and introduces nine indices summarising how developed financial institutions and financial markets are in terms of their depth, access, and efficiency. The sub-indices are aggregated into an overall index of financial

development which covers 183 countries on annual frequency between 1980 and 2017. Further in the thesis, I employ this index due to its aggregated approach to the phenomenon of financial development.

2.2 Economic growth: history, paradigms and measurement

Economic growth of a country is *"a sustained increase in its population and product per capita"* (Shearer, 1961). Since economic growth is a multidimensional phenomenon, increases in income and consumption do not necessarily implicate sustained improvements in living standards (OECD, 2014).

Todaro and Smith (2012) identify three main sources of economic growth:

- capital accumulation which includes all new investments in land, physical equipment and human resources by improvements in health, education and job skills;
- growth in population and hence eventual growth in the labour force;
- technological progress in new ways of accomplishing traditional tasks.

2.2.1 History of economic growth theories

From a chronological point of view, the starting point for modern growth theory is the work of Ramsey (1928), whose intertemporally separable utility function is widely used today as the Cobb-Douglas production function, despite that the economics profession did not accept or widely use this approach until the 1960s. Harrod (1939) and Domar (1946) attempted to integrate Keynesian analysis with elements of economic growth by using productivity functions with little substitutability among the inputs to argue that the capitalist system is inherently unstable. Since their work was written during or immediately after the Great Depression, their presented arguments were received sympathetically by many economists and these contributions triggered a good deal of research at the time; however, very little of this plays a role in contemporary thoughts (Barro and Sala-i-Martín, 2004).

The next impactful contributions are from Solow (1956) and Swan (1956) who presented the Solow-Swan model, neoclassical form of the production factor assuming constant returns to scale, diminishing returns to each input and some positive and smooth substitution elasticity between the inputs. By combining this model with a constant-saving-rate rule, it becomes an extremely simple general-equilibrium model of the economy. As stated in Barro and Sala-i-Martín (2004), there are two predictions from these models:

- conditional convergence: the lower the starting level of GDP per capita (relative to the long-run/steady-state position), the faster the growth rate;
- diminishing returns to capital: in the absence of continuous technology improvements, growth per capita must eventually cease.

In late 1950s and 1960s, neoclassical growth theorists recognised this modelling deficiency by assuming that technological progress occurred in an endogenous manner, so the growth model explains everything but long-run growth which is entirely determined by the rate of technological progress which stands outside the model (Barro and Sala-i-Martín, 2004).

Cass (1965) and Koopmans (1963) bring the analysis of consumer optimisation from Ramsey back into the neoclassical growth model and provided for an endogenous determination of the saving rate, allowing for richer transitional dynamics while tending to preserve the conditional convergence hypothesis and not eliminating the dependence of long-run growth rate per capita on exogenous technological progress. Their work completed the basic neoclassical growth model, but later researches have shown its extensions which allow for heterogeneity among households (Caselli and Ventura, 2000) and to incorporate preferences inconsistent in time (Barro, 1999).

After downturn in 1970s, research of economic growth experienced a boom which was initiated by work of Romer (1986) and Lucas (1988) who were motivated by the fact that determinants of long-run economic growth are much more important than the mechanics of business cycles or the countercyclical mechanisms of monetary and fiscal policies. Romer (1986), Lucas (1988) and Rebelo (1991) built on the research done by Arrow (1961), Sheshinski (1967), and Uzawa (1965), so they did not introduce a theory of technological change. In these models, growth may go on indefinitely because the returns to investment in a broad class of capital goods do not necessarily diminish as economies develop.

Research and development theories and the concept of imperfect competition began to be incorporated in the growth framework with Romer (1987, 1990) and included significant contributions by Aghion and Howitt (1992) and Grossman and Helpman (1991). In models presented by these researchers, technological advance results from purposive R&D activity which is rewarded by some form of ex post monopoly power, so if there is no tendency for the economy to run out of ideas, the growth rate can remain positive in the long run (Barro and Sala-i-Martín, 2004). The R&D theories have been

elaborated on in further research. Jones (1998) apply the research program to understanding scale effects in the growth process, Acemoglu (2003) analyses whether technological progress will be labour or capital augmenting and Aghion et al. (2001, 2005) assess the role of competition in the growth process.

2.2.2 Leading paradigms of economic growth

According to Aghion and Howitt (2009), the primary reference in growth economics is the neoclassical paradigm where the growth process is described by:

- a production equation which expresses the current flow of output goods as a function of the current stocks of capital and labour:

  $$Y = A \cdot K^{\alpha} \cdot L^{1-\alpha} \tag{2.1}$$

  where A is a productivity parameter and where $\alpha < 1$ so that productions involve decreasing returns to capital;
- a law of motion that shows how capital accumulation depends on investment (equal to aggregate savings) and capital depreciation:

  $$\dot{K} = sY - \delta K \tag{2.2}$$

  where sY denotes aggregate savings and δK denotes aggregate capital depreciation.

The neoclassical model implies that in the long run, economic growth does not depend on economic conditions; in other words, economic policy cannot affect a long-run growth rate of a country (Aghion and Howitt, 2009). However, this model was considered to be theoretically unsatisfactory as a tool to explore long-run growth determinants and unable to explain or rationalise technical progress. (Barro and Sala-i-Martín, 2004).

The first version of endogenous growth theory is the AK theory which does not differentiate between capital accumulation and technological progress (Aghion and Howitt, 2009). They describe the growth process by:

- an aggregate production function that is linear homogenous in the stock of capital:

  $$Y = AK \tag{2.3}$$

  where A is a positive constant reflecting the level of technology;
- the economy's long-run (and short-run) growth rate determined by capital accumulation per (2.2):

  $$g = \frac{\dot{K}}{K} = sA - \delta \tag{2.4}$$

which is increasing in the saving rate s.

The AK theory applies equally to advanced countries which have already accumulated capital and to countries that are behind in the process of capital accumulation. Similar to the neoclassical model, the growth process in AK model is independent of developments in the rest of the world, yet it can be used for many purposes when the distinction between innovation and accumulation is of secondary importance (Aghion and Howitt, 2009).

The second approach to endogenous growth theory consists of "innovation-based" models where the role of technology spillovers is emphasized. The leading example here is the product-variety model of Romer (1990), in which innovation causes productivity growth by creating new varieties of products. The model starts from a Dixit and Stiglitz (1977) production function:

$$Y_t = \sum_0^{N_t} K_{it}^{\alpha}\, di \tag{2.5}$$

where there are N_t different varieties of intermediate products produced using K_{it} units of capital. When the aggregate capital stock K_t is divided up evenly among the N_t existing varieties equally, the production function can be re-expressed as:

$$Y_t = N_t^{1-\alpha} \cdot K_t^{\alpha} \tag{2.6}$$

According to (2.6), the aggregate productivity parameter of an economy is the degree of product variety N_t and its long-run growth rate per capita output is the product variety growth rate. The model is limited by the fact there is only one kind of innovation and predictions of no important role for exit and turnover; however, it can be used in the contexts where competition and turnovers are not important enough to be considered (Aghion and Howitt, 2009).

The fourth and final paradigm is theory developed in Aghion and Howitt (1992) and elaborated in Aghion and Howitt (1997) which grew out of modern industrial organisation theory and is commonly referred to as Schumpeterian growth theory. It involves Schumpeterian force of creative destruction and focuses on quality-improving innovations that render old products obsolete (Aghion and Howitt, 2009). The theory begins with a production function specified at the industry level:

$$Y_{it} = A_{it}^{1-\alpha} \cdot K_{it}^{\alpha} \tag{2.7}$$

where A_{it} is a parameter of productivity attached to the most recent technology used in industry i at time t, K_{it} represents the flow of a unique intermediate product in this sector and aggregate output is the sum of the industry-specific outputs Y_{it}. The first implication of the Schumpeterian paradigm is that faster growth generally implies a higher rate of firm turnover, because this process of creative destruction generates entry of new innovators and exit of former innovators. The growth rate is specified as:

$$g_t = \frac{A_{t+1} - A_t}{A_t} = \mu_n(\gamma - 1) + \mu_m(a_t^{-1} - 1) \quad (2.8)$$

where A_t is the economy's productivity parameter, μ_n is frequency of sector leading-edge innovations, μ_m is frequency if implementation innovations/imitations and a_t is an inverse measure of "distance to the frontier".

Schumpeterian theory provides a framework in which the growth effects of various policies are highly context dependent. In particular, the Schumpeterian apparatus is well suited to analyse how a country's growth performance will vary with its proximity to the technological frontier at, to what extent the country will tend to converge to that frontier, and what kinds of policy changes are needed to sustain convergence as the country approaches the frontier (Aghion and Howitt, 2009).

2.2.3 Measures of economic growth

Economic growth is defined as the increase of output in an economy (e. g. a nation, a region or a municipality). In this chapter, I introduce two common measures of economic growth – gross domestic product and gross value added.

Gross domestic product (GDP) measures the monetary value of final goods and services produced in a country in a time period (e. g. a quarter or a year). To compare GDP across countries, the conversion is done through purchasing power parities, which control for differences in the price levels of products between countries to allow international comparison (OECD, 2010). Changes in the size of economies and the general health of an economy are usually measured and compared by changes in the volume of GDP where the changes caused by inflation are removed (henceforth "GDP growth"). To capture average living standard or economic well-being, the GDP is calculated as a ratio to a population of a country (henceforth "GDP per capita"). Callen (2020) states that GDP can be viewed in three different ways:

- the production approach: GDP as a summary of "value added" at each stage of production (value-added are total sales less the value of intermediate input into the process of production);
- the expenditure approach: GDP includes the values of purchases made by final users (e. g. consumption of households, investments of companies and purchases by governments);
- the income approach: GDP suns the incomes generated by production (e. g. compensation of employees and the operating surplus of companies).

However, GDP does not include all productive activity, such as unpaid work or black-market activities, as these are difficult to measure.

Gross value added (GVA) measures the contribution of each individual producer, industry or sector to the economy. In other words, it is the value of goods and services that have been produced less the costs of all inputs and raw materials attributable to that production. This variable represents the value of labour and capital used in producing gross output. GVA can be decomposed into the following components:

- compensation of employees: wages, salaries and the value of social contributions paid by employers;
- gross operating surplus: the remuneration of the production factor capital;
- mixed income: the surplus or deficit accruing from production by unincorporated enterprises owned by households;
- other taxes on production less subsidies on production.

One of its advantages is that it avoids problems inherent in the measurement of growth as a gross concept, as it measures the value that a resident unit adds to the values of the input-supplying units (OECD, 2010). Compared to GDP, GVA includes the financial intermediation services indirectly measured (FISIM) and is measured net of taxes and subsidies on products (ECB, 2003). These two aspects cause that when the two economic growth measures are compared, there are some empirical discrepancies, making employment of both indicators useful in my thesis.

2.3 Macroprudential policy: scope, instruments and measurement

2.3.1 Definition and scope of macroprudential policy

Macroprudential policy is defined as set of tools used to limit systemic risks to the financial sector and includes actions related to the whole sector or its significant parts aiming at identification and prevention of the vulnerabilities build-ups in the sector as a whole (Cecchetti and Schoenholtz, 2011; ECB, 2017a). According to IMF (2013b), systemic risk usually arises through:

- the tendency of the financial system to amplify adverse aggregate shocks,
- macro-financial feedback mechanisms resulting in an overexposure to such shocks,
- linkages within the financial sector that increase its vulnerability to idiosyncratic or aggregate shocks.

Cecchetti and Schoenholtz (2011) state that externalities causing systemic risks have two sources: common exposure of intermediaries to frail institutions or to underlying risks and pro-cyclicality of the links between financial and economic activity which amplifies boom and bust cycles. By mitigating systemic risks, macroprudential measures aim to reduce the frequency and severity of financial crises (IMF, FSB and BIS, 2016).

Macroprudential policy is based on six principles: pre-emptive and counter-cyclical character, relying on the financial cycle concept, paramount importance of the real estate aspect in the financial cycle, macroprudential dimension in stress tests of the banking and financial system, complementarity and comparable status to monetary policies and encompassing market-based finance institutions or products beyond the banking sector (ECB, 2016b). According to Financial Stability Forum (2009), Committee on the Global Financial System (2010) and IMF (2013), macroprudential policy pursues the following **intermediate objectives**:

- increasing financial system resilience to aggregate shocks by building and releasing buffers that help maintain the ability of the financial system to function effectively, even under adverse conditions;
- containing the build-up of systemic vulnerabilities over time by reducing procyclical feedback between asset prices and credit and containing unsustainable increases in leverage, debt stocks, and volatile funding;

- controlling structural vulnerabilities within the financial system that arise through interlinkages, common exposures, and the critical role of individual intermediaries in key markets that can render individual institutions "too-big-to-fail".

According to FSB, IMF and BIS (2011), macroprudential policy also interacts with other spheres of public policy because:

- other policies have an impact on systemic risk: e. g. monetary policy can affect risk-taking incentives[1], fiscal policy and public debt levels can be an important source of vulnerability for the financial sector;
- macroprudential policy interventions have macroeconomic effects: e. g. raising capital requirements in a credit boom may to some extend dampen aggregate demand and therefore influence the macroeconomic policy environment.

As these interlinkages exist, effective macroprudential frameworks require institutional arrangements and governance structures that take national circumstances into account and can ensure open and frank dialogue among the policymakers on policy choices that aim at impacting on systemic risks, resolving conflicts among policy objectives and instruments and mobilising the right tools and instruments to limit systemic risk (FSB, IMF and BIS, 2011).

2.3.2 Macroprudential policy instruments and strategic framework

According to ESRB (2014), macroprudential policy instruments can be divided by their objectives:

- **addressing excessive credit growth and leverage:** the countercyclical capital buffer (CCyB)[2], loan-to-value (LTV), loan-to-income (LTI) and debt service-to-income (DSTI) caps, sectoral requirements, macroprudential use of Pillar 2, the systemic risk buffer (SRB)[3], additional own funds requirements and capital conservation buffer, leverage ratio[4];

[1] The interactions between monetary and macroprudential policies are further analysed in Chapter 2.7.
[2] The countercyclical capital buffer (CCyB) is designed to help counter pro-cyclicality in the financial system, as capital should be accumulated when cyclical systemic risk is judged to be increasing, creating buffers that increase the resilience of the banking sector during periods of stress when losses materialise (ESRB, 2020b)
[3] The systemic risk buffer (SyRB) may vary across institutions/sets of institutions and aims to address systemic risks of a long-term, non-cyclical nature that are not covered by the CRR (ESRB, 2020e).
[4] The aim of the leverage ratio is to act as a complement and a backstop to risk-based capital requirements, as it should counterbalance the build-up of systemic risk by limiting the effects of risk weight compression during booms (Brei and Gambacorta, 2014).

- **addressing excessive maturity mismatch and market illiquidity:** net stable funding ratio (NSFR)[5], liquidity buffer ratios (liquidity coverage ratio[6]), liquidity charges, other stable funding requirements (e. g. loan-to deposit (LTD) limits);
- **addressing direct and indirect exposure concentration:** large exposures restrictions, capital-based instruments (e. g. sectoral capital requirements, SRB, own funds requirements, capital conservation buffer[7]);
- **addressing misaligned incentives and moral hazard:** globally systemically important institutions (G-SII) buffer, other systemically important institutions (O-SII) buffer, SRB, additional own funds/conservation buffer requirements, additional liquidity requirements.

To use macroprudential instruments, relevant authorities have to develop a macroprudential policy strategy, which relates objectives to indicators and instruments. The macroprudential policy cycle presented by ESRB (2014) comprises of four stages of a macroprudential policy strategy:

- **risk identification and assessment:** based on monitoring of the sources of systemic risk in a well-defined set of key indicators, macroprudential authorities must assess whether there is a possible threat to financial stability and whether macroprudential interventions are appropriate;
- **instrument selection and calibration:** when selecting macroprudential instruments, authorities must reflect the underlying sources of risk and should therefore consider economic, legal and cross-border aspects, as the instrument(s) should target the type, nature and source of systemic risk, be proportionate to the level of risk, limit arbitrage opportunities and negative cross-border spillovers and foster market discipline and expectations;
- **policy implementation:** a number of cross-cutting issues arise when implementing macroprudential policy, including the role of guided discretion (inaction bias), policy coordination and communication;

[5] The net stable funding ratio (NSFR) aims to promote resilience over a longer time horizon by creating incentives for banks to fund their activities with more stable sources of funding on an ongoing basis (FSI, 2018b)

[6] The liquidity coverage ratio (LCR) is designed to ensure that banks hold a sufficient reserve of high-quality liquid assets (HQLA) to allow them to survive a period of significant liquidity stress lasting 30 calendar days (FSI, 2018a).

[7] The capital conservation buffer (CCoB) is a capital buffer of 2.5% of a bank's total exposures aiming at conservation of a bank's capital that needs to be met with an additional amount of Common Equity Tier 1 capital (ESRB, 2020a).

- **policy evaluation:** after activation of a macroprudential policy instruments, authorities should monitor and evaluate its effects which is also useful for refining the other stages of the policy cycle.

2.3.3 Macroprudential policy measures and evaluation

On cross-country level, Cerutti et al. (2015) document the use of macroprudential policies for 119 countries between 2000 and 2017 based on the IMF's Global Macroprudential Policy Instruments (GMPI) survey. Cerutti et al. (2017) focus on changes in the intensity in the usage of several widely used prudential tools, taking into account both macroprudential and microprudential objectives and their dataset cover 64 countries between 2000 and 2014 on a quarterly period[8].

On the EU level, Budnik and Kleibl (2018) introduce a comprehensive dataset on policies of macroprudential nature in the banking sector of the 28 member states between 1995 and 2014. Their Macroprudential Policies Evaluation Database (MaPPED) offers a detailed overview of the "life-cycle" of policy instruments which are either genuinely macroprudential or are essentially microprudential but likely to have a significant impact on the whole banking system. European Systemic Risk Board (ESRB) collects information on macroprudential measures taken to target systemic risks in the real estate sector and those that are not harmonised by the EU law (Kochanska, 2017; ESRB, 2020e-f). Examples include caps to LTV, DTI and DSTI ratios.

Buch et al. (2018) discuss how macroprudential policy evaluation can be structured to improve public understanding of their effects and how the structured policy process can enhance the efficiency and effectiveness of the existing macroprudential framework in Europe. They argued that both risks associated with uncertainty about effectiveness of macroprudential policy instruments (inaction bias and the risk of choosing an inappropriate instrument or inadequate calibration) can be mitigated if macroprudential policy is embedded in a four-step structured policy process. Such process involves defining policy objectives, choosing intermediate objectives and appropriate indicators, linking instruments to the indicators through ex-ante evaluation studies and analysing the effects of these policies through ex-post evaluation studies.

[8] Further elaboration on these macroprudential policy indicators is available in Chapter 3.5.2.

For further use in my thesis, I employ the index by Cerutti et al. (2015) to capture frequency of macroprudential policy use and the index by Cerutti et al. (2017) to account for the effects of implemented policy measures.

2.4 The role of financial sector in economic growth

Beck (2015) states that economic theory pointed out different channels and mechanisms through which financial system can support economic development:

- by providing payment services and reducing transaction costs which enable efficient exchange of goods and services together with labour specialisation;
- by pooling savings from many individual savers to help overcoming investment indivisibilities and allowing exploitation of scale economies;
- by economising on screening and monitoring costs, thus increasing overall investment and improving allocation of resources;
- by helping to reduce liquidity risk to enable long-term investments;
- by helping to diversify cross-sectional and inter-temporal risk.

In this chapter, I review the existing literature on the relationship between financial development and economic growth. First, I discuss the direction of causality in the relationship. Second, I provide a timeline of seminal studies of the relationship. Third, I review the studies focusing on relationship between financial sector components and economic growth. Fourth, I examine the views in literature on impact of financial sector structure on growth. Fifth, I include the implications of financial crises. Lastly, I summarise existing literature on industry- and firm-level of studies on the finance-growth relationship.

2.4.1 Direction of causality in the finance-growth relationship

An important set of authors in the literature agrees that there is a relation between finance and economic growth. However, they disagree about the direction of causality.

The first group of authors has theoretically and empirically shown that there is causal direction from financial development to economic growth. In other words, policies moving toward the development of financial systems lead to economic growth. This argument is supported by the works of McKinnon (1973), King and Levine (1993), Levine et al. (2000), and Christopoulos and Tsionas (2004).

The second group argues that the direction is from economic growth to financial development. Since the economy is growing, there is an increasing demand for financial services that induces an expansion in the financial sector. This view is supported by the research conducted by Gurley and Shaw (1967), Goldsmith (1969), and Jung (1986).

The third group postulates that the causal direction is two-way, so financial development and economic growth reinforce each other. Patrick (1966) postulate the stage of development hypothesis. At the early stage, causality runs from finance to growth, but at later stages causality runs from growth to finance. In the early stage of economic development, finance causes growth by inducing real capital formation per capita. Later on, the economy is in the growth stage and there will be increasing demand for financial services, which induces an expansion in the financial sector as well as the real sector, thus it implies causality from growth to finance. Blackburn and Hung (1998) establish a positive two-way causal relationship between growth and financial development. According to them, private informed agents obtain external financing for their projects through incentive-compatible loan contracts enforced through costly monitoring activities that lenders may delegate to financial intermediaries. Khan (2001) also establish a positive two-way causality between finance and growth. He states that when borrowing is limited, producers with access to loans from financial intermediaries obtain higher returns, creating an incentive for others to undertake the technology necessary to access investment loans, which in turn reduces financing costs and increases economic growth.

2.4.2 Research on studies of finance-growth relationship

The initial idea to link finance and growth was in two seminal contributions. Bagehot (1873) argues that finance played a crucial role by facilitation the capital mobilisation for “immense works” during the Industrial Revolution. Schumpeter (1911) contends that efficient financial intermediaries spur technological progress by reallocating investment funds to those entrepreneurs with the best chances of successfully implementing innovative products, a process known as "creative destruction." This can be done by economising the costs of acquiring and processing information where better financial intermediaries are lower cost information producers with consequent ramifications for capital allocation and productivity growth (Aghion and Howitt, 1997).

Goldsmith (1969) was the first researcher who provided significant empirical evidence about the correlation of finance and growth for a cross-section of countries. He

asserts that financial intermediation has positive effect on growth due to efficiency and the volume of investment, even though he indicates the role of the latter is in his opinion less important. Although he constructed a measure of financial development (financial interrelations ratio) and defined it as the value of all financial assets over gross national product, his theoretical framework was still relatively unsophisticated.

The second class of growth models focuses on technological innovation in invention of new production processes and goods. The works of Romer (1990), Grossman and Helpman (1991) and Aghion and Howitt (1992) present models where the functions performed by the financial system affect steady-state growth by altering the technological innovation rate.

King and Levine (1993) find a strong and significant association between used proxies of financial development and economic growth and also look at the channels explaining the association between financial development and economic growth. In addition, their empirical results show that predetermined components of financial development indicators significantly predict subsequent values of growth indicators. They elaborate on Schumpeterian vision of development by incorporating key roles for financial intermediaries, stating that policies altering costliness and efficiency of financial intermediation exert a first-order influence on economic growth.

Alternatively, capital accumulation is considered to be the main factor underlying economic growth. In this case, better financial intermediaries influence growth mainly by raising domestic savings and attracting foreign capital (King and Levine, 1994). Their outcomes are in line with the argument of Kaldor (1960) who state that capital accumulation is a feature and not a fundamental cause of economic growth. King and Levine (1994) found out there is a little support for the view that capital fundamentalism should guide the agenda for research and policy advices, as:

- differences in capital per capita explain few of the differences in output per capita across countries;
- growth in capital stocks accounts for little of output growth across countries;
- investment to GDP ratio is strongly and robustly associated with economic growth.

Moreover, it is more reasonable to believe that economic growth causes investments and savings (which boost financial development) rather than that investment and savings cause economic growth.

Beck et al. (2000) find that financial intermediaries exert a large and positive impact on total factor productivity growth which contributes to overall GDP growth and that the long-run links between financial intermediary development and both physical capital growth and private savings rates are tenuous. The results of Bonfiglioli (2007) indicate that financial integration has a direct positive effect on productivity, but it does not directly affect capital accumulation.

Loayza and Ranciere (2005) state that over the long run, financial development supports and promotes economic growth, as the process of financial development involves deepening of markets and services that channel savings to productive investment and allow diversification of risk. Furthermore, their outcomes indicate that total impact of financial liberalisation and intermediation on economic growth may be a combination of conflicting effects of financial depth and fragility (captured by financial volatility and crises) and such effects would depend on stage of financial development of a country.

On the opposite hand, Robinson (1952) argued that financial development follows growth, articulating this causality argument by a statement "where enterprise leads finance follows". Furthermore, he considered the possibility of bidirectional causation of the finance and growth link. According to this view, economic growth creates demands for specific types of financial arrangements and the financial system responds automatically to these demands (ECB, 2001).

Lucas (1988) dismisses finance as an over-stressed determinant of economic growth. Miller (1998) states that the contribution of financial markets to financial growth is so obvious it does not even warrant discussion. Cecchetti and Kharroubi (2015) study the real effects of financial sector growth and find out that the growth of a country's financial system in a drag on productivity growth. To rephrase it, financial booms are not enhancing growth in general, likely because the financial sector competes with the rest of the economy for resources. Arcand et al. (2015) examine whether there is a threshold above which financial depth no longer has a positive effect on economic growth and conclude that financial depth starts having a negative effect on growth when the credit to the private sector exceeds 100 % of GDP.

2.4.3 Impact of financial sector components on economic growth

Boyd and Prescott (1986) conclude that banks play a key role in reducing information loss, leading to more efficient resource allocation, while other studies

propose that the financial sector underperform in terms of finance allocation compared to the banking sector (Bhide, 1993; Stiglitz, 1985). Another group of studies stresses that stock markets overcome banks in promoting economic growth. These theories emphasize that the financial sector is not only free from the monopolistic and conservative environment that the banking sector impose to the economy but also encourages innovation and competition stimulating growth in more effective ways (Georgantopoulos et al., 2015).

Levine and Zervos (1998) employ stock market capitalisation and stock market turnover to study the association between equity market properties and economic growth and they study how capital accumulation and productivity growth are affected by stock market development. Their results suggest that stock market liquidity has independent positive effects on economic growth and they also find the beginning-of-period levels of stock market liquidity are positively and significantly correlated with subsequent rates of physical capital accumulation and productivity growth. Furthermore, the data fail to reject the hypothesis that stock market size is not robustly correlated with growth, suggesting that stock trading ability fosters investment, resource reallocation and ultimately growth rather than ability to list it.

Levine et al. (2000) find out that exogenous components of development of financial intermediaries (e. g. private credit on growth and liquid liabilities) are positively associated with economic growth and that differences among countries in legal and accounting systems help account for differences in the development. Their findings indicate that legal and accounting reforms aimed at improving and strengthening creditor rights, contract enforcement and accounting practices can support financial development and contribute to faster economic growth. Cole et al. (2008) find a positive and significant relationship between bank stock returns and future GDP growth independent of the previously documented relationship between market index returns and economic growth.

According to Shen and Lee (2006), stock market development has positive effects on growth while banking development has an unfavourable, if not negative, effect on growth. In their empirical results, conditional variables of middle-income level and continental dummies strengthen the positive impact of stock market development on growth, whereas the conditional variables of financial liberalisation mitigate such positive impacts. Furthermore, financial development and growth may be in a nonlinear form, as

relationship between growth and bank development is better described as a weak inverse U-shape when additional stock market variables are squared.

Results of Bittencourt (2012) confirm the Schumpeterian prediction, suggesting that finance authorises the entrepreneurs to invest in productive activities which promote economic growth. He highlights importance of a more open, competitive and therefore active financial sector in channelling financial resources to entrepreneurs, the relevance of macroeconomic stability (in terms of low inflation rates) and the institutional framework (central bank independence and fiscal responsibility laws) and structural reforms as key pre-conditions for financial development resulting in sustainable growth. Cecchetti and Kharroubi (2015) find that credit booms harm more R&D-intensive growth engines, so there is a pressing need to reassess the relationship between finance and real growth in modern economic systems.

2.4.4 Impact of financial sector structure on economic growth

In a cross-country context which is used in this thesis, there is no general rule that bank-based[9] or market-based[10] financial systems are better at promoting economic growth. Levine (2002) finds that after controlling for the overall level of financial development, information on financial structure does not help in explaining cross-country differences in financial development. However, Tadesse (2002) argues that while market-based systems outperform bank-based systems among countries with developed financial sectors, bank-based systems are far better among countries with underdeveloped financial sectors.

Using industry-level data, research finds that financially dependent industries do not expand at higher rates in bank-based or market-based financial systems. Beck and Levine (2002) confirm that greater financial development accelerates the growth of financially dependent industries. Financial structure per se, however, does not help explain the differential growth rates of financially dependent industries across countries.

Access of firms to external finance is not easier, and firms do not grow faster in either market-based or bank-based financial systems. Demirgüç-Kunt and Maksimovic

[9] In bank-based systems, banks play a leading role in mobilisation of savings, allocation of capital, oversight of investment decisions of corporate managers and provision of risk management vehicles (Demirgüç-Kunt and Levine, 1999).

[10] In market-based systems, securities markets share central position with banks in getting savings of the society to firms, exerting corporate control and easing risk management (Demirgüç-Kunt and Levine, 1999).

(2002) extend their earlier study and show that overall financial development helps explain the excess growth of firms across countries, i.e., the proportion of firms that grow at rates exceeding the rate at which each firm can grow with only retained earnings and short-term borrowing is positively associated with overall financial development. However, the degree to which countries are bank-based or market-based does not help explain excess growth.

Carlin and Mayer (2003) examine the relationship between the structure of the financial system and types of activities conducted in different countries. They find a positive association between information disclosure (as measured by the effectiveness of the accounting system), the fragmentation of the banking system (as measured by low bank concentration), and the growth of equity-financed and skill-intensive industries. Their outcomes are consistent with models by Allen and Gale (1999) and Boyd and Smith (1998) which conclude that high technology firms require financial systems that allow for diverse views, such as equity markets rather than banks which provided more standardized monitoring. This result is also consistent with models by Dewatripont and Maskin (1995) that focus on renegotiations where fragmented banking systems tend to impose short-term, tighter budget constraints.

The above presented outcomes do not necessarily imply that institutional framework is unimportant for growth. Rather, they may imply that there is not one optimal structure for providing growth-enhancing financial functions to the economy (Merton and Bodie, 2004). In addition, the growth-maximizing mixture of markets and intermediaries may depend on legal, regulatory, political, and other factors that have not been adequately incorporated into current theoretical or empirical research. In research, aggregate cross-country indicators of the degree to which countries are bank-based or market-based are used and these indicators may not sufficiently capture the comparative roles of banks and markets and may not be sufficiently country-specific to gauge accurately national financial structure (Levine, 2005).

2.4.5 Implications of financial crises for economic growth

Financial crisis is a disturbance to financial markets which spreads through the financial sector and results in disrupting the market's capacity for capital allocation (Eichengreen and Portes, 1987). Claessens and Kose (2013) identified four common features of such crisis:

- increases in asset price that turned out to be unsustainable,
- credit booms leading to excessive debt burdens,
- build-up of marginal loans and systemic risk,
- failure of regulation and supervision to keep up with financial development and get ahead of the crisis when it erupted.

Furthermore, they added four key new aspects related to the recent global financial crisis:

- widespread use of complex and opaque financial instruments,
- increased interconnectedness among financial markets, both nationally and internationally,
- high degree of leverage of financial institutions,
- central role of the household sector.

Financial crisis can impact potential output through direct and indirect channels. Direct effects are observable within all elements of the production function:

- lowering incentives to invest in capital by decreasing demand for products and raising uncertainty on investment returns and risk premia (Pindyck, 1991; Pindyck and Solimano, 1993),
- weakening the labour market situation which can result in increase in the structural unemployment rate (Ball, 2009),
- two competing effects on labour force participation – additional worker effect (Debelle and Vickery, 1998) and discouraged worker effect (Elmeskov and Pichelmann, 1993),
- uncertain effect on total factor productivity (Furceri and Mourougane, 2009).

On the other hand, financial crisis can influence potential output through indirect effects which include:

- policy responses from public authorities to cushion the economic downturn (Reinhart and Rogoff, 2008),
- temporary fiscal measures that can lead to permanent increase in government size and in debt levels, thus negatively affecting growth (Afonso and Furceri, 2008),
- fostering implementation of structural reforms that can enhance potential output (Høj et al., 2006).

Cerra and Saxena (2008) analyse the impact of both financial and political shocks on output in a broad set of countries in an autoregressive panel model where financial shocks include currency, banking and twin financial crises. Their results indicate that the impact of a currency crisis on GDP growth is negative and highly persistent and that the depth of the loss varies by income group (there is a modest impact on high-income countries). The impact of a banking crisis is nearly twice as large as a currency crisis and lead to severe output loss in high-income countries. Output loss from twin financial crises is deeper in either of the individual crises while the persistence of the loss is robust to all regional and income groups except for the Latin America subset.

Abiad et al. (2009) use a sample of 88 banking crises from a wide range of countries to find out that on average, output does not rebound to its pre-crisis trend path, but remains permanently below it, since there are observable reductions of roughly equal proportions in the employment rate, the capital-to-labour ratio and total factor productivity. Their findings indicate a large variation across analysed countries, as medium-run output losses are robustly correlated with the change in output in the first year of the crisis, the occurrence of a joint banking-and-currency crisis and high pre-crisis level of investment. In addition, their results are consistent with the notion that policies implemented in the aftermath of a crisis can help to mitigate the impact on output.

Furceri and Mourougane (2009) follow the methodology of Cerra and Saxena (2008) and found out that financial crises have a negative and persistent effect on potential output and that the magnitude of the effect increases with the severity of the crisis. However, their results are limited to estimate an average impact and do not allow the analysis to differentiate the impact by country, nor to interact crisis effects with structural policy indicators.

Ball (2014) estimate the long-term effect of the 2008-2009 global recession on output in 23 countries by comparing current estimates of potential output from the OECD and IMF to the path the potential was following in 2007 according to estimates at the time. He found out that loss in potential output varies greatly across the sample of countries (from almost nothing in Switzerland and Australia to over 30% of potential output in Greece, Hungary and Ireland). Furthermore, his results indicate that in most countries, the loss of potential output is almost as large as the shortfall of actual output from its pre-crisis trend which implies that hysteresis effect have been very strong during the crisis. Moreover, in the countries which were affected the most, the growth rate of potential

output is significantly lower in 2014 than it was before 2008, which in Ball's opinion means that the level of potential output is likely to fall even farther below its pre-crisis trends in the following years.

2.4.6 Industry level studies of finance and growth

In the first influential study of the industry level, Rajan and Zingales (1998) argue that better-developed financial intermediaries and markets help overcome market frictions which drive a wedge between the price of external and internal finance. In their opinion, industries that are naturally heavy users of external finance should benefit disproportionately more from greater financial development than industries that are not naturally heavy users of external finance. Their outcomes received critique from Fisman and Love (2003), who state that used methodology does not test the extent to which financial systems foster the growth of industries with an inherent financial dependence. However, Beck and Levine (2002) confirm their findings by using alternative measures of financial development.

Cetorelli and Gambera (2001) examine the role of banking sector concentration on firm access to capital by using the methodology of Rayan and Zingales. They found out that bank concentration promotes the growth of industries that are naturally heavy users of external finance, but bank concentration has a depressing effect on overall economic growth. Claessens and Laeven (2005) disagree with such outcomes, noting that market concentration is not necessarily a good measure of industry competitiveness. They then show that naturally heavy users of external finance grow faster in countries with more competitive banking system, while they find no evidence that banking industry concentration explains industrial sector growth.

Claessens and Laeven (2002) build on the study of Rayan and Zingales (1998), as they examine the joint impact of financial sector development and the quality of property rights protection on the access of firms to external finance and the allocation of resources. Their results show that financial sector development hurts growth by hindering the access of firms to external finance and insecure property rights hurts growth by leading to a suboptimal allocation of resources by distorting firms into investing excessively in tangible assets. Thus, even when controlling for property rights protection, financial development continues to influence economic growth. However, their conclusions are different from the study of post-communist countries presented by Johnson et al. (2002),

who find that property rights dominate access to external finance in explaining the degree to which firms reinvest their profits.

Beck et al. (2004) extend the approach of Rayan and Zingales and highlight another channel which connects finance and growth – removing impediments to small firms. Their results indicate that industries naturally composed of small firms grow faster in financially developed economies. These results are consistent with the view that small firms face greater informational and contracting barriers to raising funds than large firms, so that financial development is particularly important for the growth of industries that, for technological reasons, are naturally composed of small firms.

Wurgler (2000) computes an investment elasticity that gauges the extent to which a country increases investment in growing industries and decreases investment in declining ones. This is an important contribution because it directly measures the degree to which each country's financial system reallocates the flow of credit. He shows that countries with higher levels of financial development both increase investment more in growing industries and decrease investment more in declining industries than financial underdeveloped economies.

2.4.7 Firm level studies of finance and growth

Demirgüç-Kunt and Maksimovic (1998) examine whether financial development influences the degree to which firms are constrained from investing in profitable growth opportunities. By analysing accounting data for the largest publicly traded manufacturers in 26 countries, they find that both banking system development and stock market liquidity are positively associated with the excess growth of firms. Beck et al. (2001) confirm their findings by using an extended sample of data.

Love (2003) finds that the sensitivity of investment to internal funds is greater in countries with more poorly developed financial system. In his findings, consistent with those of Demirgüç-Kunt and Maksimovic (1998) and Rayan and Zingales (1998), he implies that greater financial development reduces the link between the availability of internal funds and investment as well as that financial development is particularly effective at easing the constraints of small firms.

Besides analysis at the industry level, Beck et al. (2004) investigate the effect of financial development on easing the obstacles that firms face to grow faster. They show that financial development weakens the impact of various barriers to firm growth and that

small firms benefit the most from financial development. On the other hand, Kumar et al. (1999) show that financial development is associated with larger firms, suggesting that low levels of financial development constraint firm growth.

Dyck and Zingales (2004) provide additional firm-level evidence on the mechanisms through which financial development influences growth by examining whether financial development influences the private benefits of controlling a firm. If there are large private benefits of control, this implies that insiders can exploit their positions and help themselves at the expense of the firm. The resultant loss of corporate efficiency could have aggregate growth effects. They find that the benefits of control are greater in countries with poorly developed financial systems. While not linked with aggregate growth, this suggests that financial development improves the corporate governance of firms.

2.5 Financial development and macroprudential policy

Blanchi et al. (2012) develop a dynamic stochastic general equilibrium framework in which the interaction between financial innovation, credit frictions and imperfect innovation is the core of the financial transmission mechanism to study the effects of macroprudential policy. Their results show that the effectiveness of macroprudential policy depends on the government's information set, the tightness of credit constraints and the pace at which optimism surges in the early stages of financial innovation. In their opinion, macroprudential policy is least effective when the government is as uninformed as private agents, credit constraints are tight, and optimism builds quickly.

Agénor et al. (2018) study the effects of prudential regulation, financial development, and financial openness on economic growth. According to their analytical review, prudential regulation can affect growth through a variety of channels, beyond the risk-taking effects typically emphasized in the literature. Moreover, these channels can impact growth in conflicting ways, implying that theoretically the net effect of prudential regulation is ambiguous. Their empirical results from a panel regression show that growth may be promoted by prudential policies whose goal is to mitigate financial risks to the economy. Such policies should be aimed at promoting financial development and financial integration and coordinated across countries, as setting structural prudential rules may help to promote growth. At the same time, financial openness tends to reduce

the growth benefits of these policies, possibly because of either more opportunities to borrow abroad or increased scope for cross-border leakages in regulation.

Bernier and Plouffe (2019) use research and development (R&D) spending in the financial sector to assess the relationship between financial innovation and economic growth and evaluate the influence of macroprudential policy on such relationship. Their results indicate a net-positive relationship between financial innovation and gross capital formation and no evidence of a net-negative impact of financial innovation on growth, thus challenging the popular and political stigma which surrounds financial innovation and little robust evidence of macroprudential policy influencing the relationship between innovation in the financial sector and economic growth. However, while macroprudential policy itself may be positively related to economic growth, its interactive effect is to reduce any potential influence of financial innovation.

2.6 Macroprudential policy and economic growth

Agénor (2016) studies growth and welfare effects of macroprudential regulation in an overlapping generations model of endogenous growth with banking and agency costs. First, it was shown that the direct effect on investment and economic growth of higher reserve requirements, aimed at improving incentives for depositors or mitigating systemic financial risks by reducing private sector leverage, may be negative when monitoring intensity is taken as given. However, the same policy has conflicting effects on growth when monitoring intensity is endogenized because it also affects banks' incentives to monitor. The trade-off between promoting financial stability and fostering economic growth can therefore be internalized by setting the required reserve ratio at its optimal value.

Sánchez and Röhn (2016) find out that countries with more effective prudential banking supervision experience less severe negative shocks and that the use of several macroprudential policies is associated with less extreme positive growth shocks. Their results are consistent with the fact that macroprudential policies are mainly ex-ante and meant to reduce the boom phase of the economic cycle (Cerutti et al., 2015). However, during normal times there appears to be cost involved in their use, as the average growth is reduced.

Boar et al. (2017) investigate the link between macroprudential policies and economic performance measured by output volatility and growth over a five-year period.

Their results indicate that the more a country uses macroprudential policies, the higher is the growth rate of its per capita GDP and the less volatile its GDP growth. Moreover, the beneficial effects of macroprudential policies on output growth and volatility are found to depend on the degree of economy openness and financial development. For economies that are either very open or very financially developed (but not both), macroprudential policies tend to be less effective. On the other hand, with a sufficiently high degree of development and openness, macroprudential measures gain in effectiveness.

Neanidis (2019) explores whether banking regulation mitigates the adverse effects of capital flows volatility on economic growth. The results indicate that banking supervision contributes to the growth by diminishing the negative impact of volatile capital flows. The findings are valid for both aggregate capital flows and its various components, and its net and gross counterparts and they are also robust for various measures capturing regulatory policies. The results support the argument that regulatory policy focusing on banks which is designed to ensure financial stability is a positive contributor to long-run economic growth.

2.7 Macroprudential policy and other public policies

As mentioned in Chapter 2.2.1, macroprudential policy closely interacts with other spheres of public policy. Macroprudential and monetary policy both target macroeconomic stability and affect real economic variables and this interaction depends on whether financial imbalances play a role in the monetary policy framework (Galati and Moessner, 2011). Fiscal policy and public debt levels can be an important source of vulnerability for the financial sector (FSB, IMF and BIS, 2011).

Borio and Drehmann (2009) support the use of monetary policy to address financial imbalances. They also stress that relying only on macroprudential policy to address (the time dimension of) financial instability would burden it too much. Angelini et al. (2012) use a dynamic general equilibrium model to assess the interaction between macroprudential policy and monetary policy. Their results indicate that when economic fluctuations are driven by supply shocks, the use of counter-cyclical capital requirements has limited effects on macroeconomic stability. The lack of cooperation between the macro-prudential authority and the central bank may increase the volatility of the policy instruments. This conflict is due to the coexistence of independent authorities, whose

policies influence closely related variables but have different objectives. When the economy is, instead, hit by financial shocks, macro-prudential policy is effective in stabilizing the economy.

Aikman et al. (2019) describe how interest rates and macroprudential policy – as captured by the countercyclical capital buffer (CCyB) – interact in response to different shocks. They find that deploying the CCyB improves outcomes significantly relative to when monetary policy is the only tool – this reinforces the rationale for having expanded central-bank toolkits to include this policy lever. But despite its powerful role, the CCyB should be used less aggressively when monetary policy is constrained at the effective lower bound.

Martinez-Miera and Repullo (2019) propose a stylized general equilibrium model to assess the effects of monetary and macroprudential policies on the risk-taking incentives of financial intermediaries. Their results show that the optimal combination of both policies is closer in terms of both financial stability and social welfare to the optimal stand-alone macroprudential policy than to the optimal stand-alone monetary policy and thus support the view that macroprudential policy should be the primary tool for addressing risks to financial stability.

2.8 Summary of the chapter

This chapter provides an overview of analysed phenomena in terms of their definition, scope, objectives and measures. Financial development includes factors, policies, and institutions that lead to effective financial intermediation and markets, as well as deep and broad access to capital and financial services (WEF, 2012). It can be measured by single indicators (proxies) and complex indices containing multiple indicators. Economic growth mainly determines the material well-being of billions of people and its modelling is a topic for theoretical and empirical research (Aghion and Howitt, 2009). Macroprudential policy contributes to the safeguarding of the stability of the financial system as a whole (ESRB, 2014). The use of macroprudential policy instruments in the European Union can be documented in cross-country datasets combined with national reports to the ESRB.

The relationship between financial development and economic growth has been widely discussed among researchers. Theoretical and empirical studies on cross-country, country, industry and firm levels focus on the direction of causality in the relationship,

whether the link between finance and growth exists, how components and structure of the financial sector impact economic growth and impacts of financial crises. For this thesis, the most relevant study on the finance-growth is from King and Levine (1993) as it both explores and explains association between these phenomena.

In review of studies focusing on interactions between financial development and macroprudential policy, I found out the paper written by Agénor et al. (2018) as the most relevant to this thesis. In the paper, effects of prudential regulation, financial development and financial openness on economic growth are analysed and the results show that while economic growth may be promoted by prudential policies, financial openness reduces such growth benefits.

Among the existing literature on relationship between macroprudential policy and economic growth, the most relevant study is from Boar et al. (2017). The study focuses on the link between macroprudential policies and economic performance and adds financial development and openness as factors which influence effectiveness of macroprudential measures.

3 Data and stylised facts of analysed countries

I have decided to narrow the scope of my analysis to twelve European Union member states which adopted euro as their single currency in the period from 1999 to 2001. These are Austria (AT), Belgium (BE), Finland (FI), France (FR), Germany (DE), Greece (EL), Ireland (IE), Italy (IT), Luxembourg (LU), Netherlands (NL), Portugal (PT) and Spain (ES).

I have chosen this panel of countries, because they have similar legal basis of macroprudential policy (see Chapter 3.2) and since 1999 (2001 for Greece), they have followed a single monetary policy (see Chapter 3.3). I omitted countries that adopted euro at a later stage (Cyprus, Estonia, Latvia, Lithuania, Malta, Slovakia, and Slovenia), because they did not join the euro area at once and this would be an issue in the empirical analysis.

3.1 Financial and banking sectors in the analysed countries

This chapter analyses financial and banking sector in each country in the panel. I use data from national central banks, IMF and European Banking Federation to get an overview of role of financial sector in the countries.

In **Austria**, the banking sector is highly developed and there are nearly 600 banks (Sütz, 2019). It can be divided into several sectors, the biggest ones are the joint stock banks, the Raiffeisen sector and the saving banks (Sütz, 2019). The joint stock banks, including the central institutions of the cooperative groups and savings banks, have Austrian as well as foreign shareholders, because the banks focus on Central Eastern and South Eastern Europe market as well. Prudent and timely supervisory measures have contributed to the fact that foreign currency loans no longer pose a systemic risk for the Austrian banking sector (OeNB, 2020a).

The **Belgian** banking community is characterised by a variety of players who are active in different market segments. Like the Belgian economy, the banking sector is characterised by a high degree of international openness. Of the 87 banks established in Belgium at the end of September 2018, 84% were branches or subsidiaries of foreign institutions, and only 16% had Belgian majority ownership (De Vos, 2019). Cross-border financial linkages, while still significant, have declined and Brussels remains the home of globally significant financial market infrastructures and service providers (IMF, 2018).

Finland's financial system is relatively large with credit institutions constituting the largest share and there are significant links between some banks and non-bank financial firms (IMF, 2016a). The Finnish banking market is dominated by four major banks, which together, hold 81% of the market shares (Somerla, 2019). The banking system is highly concentrated and foreign banks play a major role – two foreign-owned banks account for 70% of banks' assets (IMF, 2016a). The concentrated and relatively large non-bank financial sector (it accounts for nearly 40 % of the financial system) plays an important role in managing savings and diversifying portfolios (IMF, 2016a).

The **French** banking sector numbers 340 banks, from which four are among the euro area Global Systemically Important Banks (G-SIBs) (Waxin, 2019). French banks finance business development as well as French consumers, as credit is one of the main growth drivers in the country. There is also a global systemically important insurer (G-SII) and a large global reinsurer (IMF, 2019b). The share of non-bank financial intermediaries is around 40 % and the insurance sector is one of the largest in the EU with more than 700 firms (IMF, 2019b).

In **Germany**, the financial system is dominated by banks (they account for two thirds of the financial sector) and is generally domestically oriented and robust to shocks (IMF, 2016b). The banking system comprises three pillars — private commercial banks, public-sector banks, and cooperative banks — distinguished by the legal form and ownership structure and has gone through a sustained period of consolidation (Brüggemann, 2019). Bank funding, in aggregate, is more reliant on deposits compared to other advanced economies (IMF, 2016b). Financial infrastructures are fewer than in other financial centres but are interconnected with G-SIBs.

The financial system of **Greece** is dominated by banks and is slowly progressing towards a new chapter after years of financial assistance programmes. The banking sector consists of 15 domestic credit institutions (the four largest control about 96 % of the banking assets) and 20 foreign banks (Vasila, 2019). Other financial intermediaries represent only a small part of the financial sector, so their impact on financial stability is smaller (Bank of Greece, 2017).

The **Irish** financial system has strengthened significantly since the crisis and undergone major structural changes (IMF, 2016c). At the end of 2018, there were 61 operating banks which included 24 credit institutions authorised in Ireland, 36

branches of banks authorised in the EEA and one branch of a non-EEA credit institution (O'Brien, 2019). The Irish government has majority stakes in two banking groups (71% stake in Allied Irish Banks and 75% in permanent tsb) and a minority stake in the Bank of Ireland (O'Brien, 2019).

The banking sector belongs to the strong points of the **Italian** economy. Banks account for almost 85 percent of total financial sector assets (IMF, 2013a). The restructuring and the consolidation of the Italian banking sector continue and is partly induced by the changing regulatory environment and the digital revolution. As of 2019, there were 113 bank holding groups and independent banks (Amici, 2019).

Luxembourg has a long-standing expertise in financial services and the banking sector is the main economic engine (Verony, 2019). The Luxembourg financial system has expanded significantly in recent decades to play a key role in the intermediation of global capital (IMF, 2017d). Luxembourg features the highest banking internationalisation rate in Europe (94.8%) with more than one third of the 136 banks coming from outside the European Union (Verony, 2019).

In **the Netherlands**, the financial system is large and globally interconnected (van Kempen, 2019). The country is home to a G-SIB and a G-SII. The banking system comprises half of the financial sector and is concentrated in four domestic banks (IMF, 2017a). The pension system is ranked first globally by share of GDP and the insurance sector has consolidated assets amounting to about 140 percent of GDP (IMF, 2017a).

The **Portuguese** banking sector comprises 152 credit institutions, 62 of which were banks (including 30 branches of foreign banks), 86 mutual agricultural credit banks and four savings banks (APB, 2019). It has undergone a very intense transformational process which resulted in significant achievements on all fronts: solvency, liquidity, asset quality and, more recently, profitability, as well as business model adjustments and governance improvements (Martinho, 2019).

Spanish financial landscape is dominated by the banking system; the rest of the financial system includes insurers, pension and investment funds, and financial vehicle corporations, most of which are part of bank-led conglomerates (IMF, 2017e). It has twelve banking groups, representing more than 90% of the industry, with 52 private banks, two saving banks and 62 cooperative banks (Rizo, 2019). Spain is also s home to

a G-SIB. At a stable 25 percent of GDP, shadow banking is small when compared with other major euro area countries (IMF, 2017e).

3.2 Macroprudential policy in the euro area

3.2.1 International approach to macroprudential policy

The Basel Committee on Banking Supervision (BCBS), committee of the Bank for International Settlements (BIS), sets the primary global standards for prudential regulation of banks and provides a forum for regular cooperation on banking supervisory matters for its 45 members (central banks and bank supervisors) from 28 jurisdictions (BCBS, 2020). BCBS has established a series of international standards for bank regulation, which are commonly known as Basel I, Basel II and Basel III.

The Basel Capital Accord (henceforth **Basel I**) was approved in 1988 and called for a minimum ratio of capital to risk-weighted assets of 8% to be implemented by the end of 1992 in virtually all countries with active international banks (BCBS, 2020). The Accord was amended in 1991 to more precisely define the general provisions or general loan loss reserves that could be included in the capital adequacy calculation (BCBS, 1991). Another amendment recognising the effects of bilateral netting of banks' credit exposures in derivative products and to expand the matrix of add-on factors was issued in 1995 (BCBS, 1995). In 1996, Market Risk Amendment and intentions of Committee member on how to recognise effects of multilateral netting were issued (BCBS, 1996; BCBS, 2005a). The Market Risk Amendment was designed to incorporate within the Accord a capital requirement for the market risks arising from banks' exposures to foreign exchange, traded debt securities, equities, commodities and options.

The revised capital adequacy framework (henceforth **Basel II**) was issued as a proposal in 1999 and released in 2004. According to BCBS (2004), it comprised three pillars:

- minimum capital requirements which develop and expand the rules from Basel I;
- supervisory review of an institution’s capital adequacy and internal assessment process;
- effective use of disclosure as a lever to strengthen market discipline and encourage sound banking practices.

Basel II was designed to improve the way regulatory capital requirements reflect underlying risks and to better address the financial developments and innovations that

had occurred in recent years. The changes aimed at elaborating on existing and continued improvements in risk measurement and control (BCBS, 2020). In 2005, BCBS published a consensus document which governs the treatment of trading books of banks under the new framework and both texts were integrated in a comprehensive document in 2006 (BCBS, 2005b; BCBS, 2020). Demands on greater degree of cooperation between home and host supervisors were addressed in guidance on information sharing in 2006 which was followed by advice on supervisory cooperation and allocation mechanisms in the context of the advanced measurement approaches for operational risk (BCBS, 2020).

The banking sector entered the global financial crisis with too much leverage and inadequate liquidity buffers, so the need for a fundamental strengthening of the Basel II framework had become apparent. The dangerous combination of poor governance and risk management and inappropriate incentive structures was demonstrated by the mispricing of credit and liquidity risks, and excess credit growth (BCBS, 2020). In 2009, BCBS issued a package of documents enhancing and strengthening the regulation and supervision of internationally active banks in the lights of weaknesses revealed by the crisis. In 2010, higher global minimum capital standards for commercial banks were announced by the Group of Governors and Heads of Supervision, the oversight body of BCBS (BCBS, 2010). This followed an agreement to come up with a new capital and liquidity reform package.

The capital and liquidity reform package (henceforth **Basel III**) was a central element of BCBS's response to the global financial crisis. It contains higher and better-quality capital, better risk coverage, the introduction of a leverage ratio as a backstop to the risk-based requirement, measures to promote the build-up of capital that can be drawn down in periods of stress, and the introduction of two global liquidity standards (BCBS, 2010). The enhanced Basel framework revises and strengthens Basel II pillars and is extended to more areas. The reforms include:

- stricter requirements for quality and quantity of regulatory capital and reinforcement of the central role of common equity;
- an additional layer of common equity (the capital conservation buffer) that restricts pay-outs to help meet the minimum common equity requirement when breached;
- a countercyclical capital buffer which places restrictions on participation by banks in system-wide credit booms with the aim of reducing their losses in credit busts;

- a leverage ratio which is a minimum amount of loss-absorbing capital relative to all of a bank's assets and off-balance sheet exposures regardless of risk weighting;
- liquidity requirements (minimum liquidity ratio, liquidity coverage ratio) intended to provide enough cash to cover funding needs over a 30-day period of stress; and a longer-term ratio, the Net Stable Funding Ratio (NSFR), intended to address maturity mismatches over the entire balance sheet;
- additional requirements for systemically important banks, including additional loss absorbency and strengthened arrangements for cross-border supervision and resolution (BCBS, 2010).

BCBS completed the Basel III post-crisis reforms in 2017 and published new standards for the calculation of capital requirements for credit risk, credit valuation adjustment risk and operational risk. The final reforms also include a revised leverage ratio, a leverage ratio buffer for global systemically important banks and an output floor, based on the revised standardised approaches, which limits the extent to which banks can use internal models to reduce risk-based capital requirements (BCBS, 2017). These final reforms address the weak points of the pre-crisis regulatory framework and provide a regulatory framework for a resilient banking system that supports the real economy. Moreover, the revisions of Basel III framework help to restore credibility in the calculations of risk-weighted assets (RWA) by enhancing the robustness and risk sensitivity of the standardised approaches for credit risk and operational risk, constraining internally modelled approaches and complementing the risk-based framework with a revised leverage ratio and output floor (BCBS, 2020).

3.2.2 Institutional framework of macroprudential policy at the EU level

Before the adoption of Basel III, the High-Level Group on financial supervision in the EU chaired by Jacques de Larosière (the de Larosière Group) called for a coherent and workable regulatory framework of financial regulations, supervisory powers and sanctioning regimes (de Larosière et al., 2009). The report suggested that harmonised set of core rules and the European framework for macroprudential supervision should be created. Harmonised set of rules contributes to a well-functioning regulatory framework and together with rules for macroprudential supervision, they ensure financial stability.

One of the outcomes of the de Larosière report was establishment of the **European Systemic Risk Board**, which is responsible for the macroprudential

oversight of the EU financial system and the prevention and mitigation of systemic risk (ESRB, 2020c). ESRB monitors and assesses systemic risk in normal times for the purpose of mitigating the exposure of the system to the risk of failure of systemic components and enhancing the financial system's resilience to shocks (Regulation (EU) No 1092/2010). In that respect, the ESRB contributes to ensuring financial stability and mitigating the negative impacts on the internal market and the real economy.

The **Single Supervisory Mechanism** (SSM) Regulation assigns macroprudential responsibilities to both national authorities[11] and the ECB (Council Regulation (EU) No 1024/2013). In particular, the Regulation gives national authorities the power to implement macroprudential measures and gives the ECB the power to tighten the measures set out in EU legislation. The ECB can also lead the analysis of cross-border effects and can support action being taken to promote reciprocation of national macroprudential policies (ECB, 2016a). The ECB and the national authorities engage in broad discussions on the use of macroprudential instruments in the SSM, both at technical and policy level. National authorities are required to notify the ESRB of their macroprudential measures in accordance with the CRD IV, the CRR and various ESRB recommendations.

The ECB's ultimate decision-making body, the Governing Council, is responsible for macroprudential policy decisions (ECB/2014/1). The Governing Council works closely with the Supervisory Board on macroprudential matters and benefits from the Supervisory Board's knowledge of the banking system. The Macroprudential Forum, composed of the members of the Governing Council and the Supervisory Board, operates as a platform for regular discussion at the highest level, bringing together the micro- and the macroprudential perspectives across the SSM (ECB, 2019a). The Financial Stability Committee is the European System of Central Banks' main technical committee supporting the ECB in the area of macroprudential policy and includes high-level representatives from the national central banks and supervisory authorities of the SSM Member States (ESRB, 2014). They meet to discuss macroprudential measures and advise the Governing Council on macroprudential concerns and potential policy responses, including the preparation of draft proposals on the use of macroprudential tools for the banking sector.

[11] Further description of national institutional frameworks in macroprudential policy is included in Chapter 3.2.4.

The coexistence of three layers of decision-making regarding macro-prudential risk – the ESRB, the ECB's Governing Council and the national authorities – makes for a complex institutional framework. Cooperation between these bodies is essential and in particular, it is very important for the ECB and the ESRB to agree on procedures to ensure information sharing and operational effectiveness (ESRB, 2014).

3.2.3 Legal framework of macroprudential policy in the euro area

In the EU law, the rules deriving from the Basel III framework have their legal basis in:

- **Capital Requirements Regulation (CRR):** Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012;
- **Capital Requirements Directive (CRD IV):** Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms, amending Directive 2002/87/EC and repealing Directives 2006/48/EC and 2006/49/EC.

The CRD IV governs the access to deposit-taking activities while the CRR establishes he prudential requirements institutions need to respect. Member States are required to transpose the CRD IV into national law, while the CRR is directly applicable, which means that it creates law that takes immediate effect in all Member States in the same way as a national instrument, without any further action on the part of the national authorities (EC, 2013).

In addition to the Basel III framework, there are number of important changes to the banking regulatory framework in the directive (Directive 2013/36/EU):

- further strengthening of the remuneration framework: For performance from 1 January 2014 onwards, the variable component of the total remuneration shall not exceed 100% of the fixed component of the total remuneration of material risk takers. Exceptionally, and under certain conditions, shareholder can increase this maximum ratio to 200%.
- enhanced governance: CRD IV strengthens the requirements with regard to corporate governance arrangements and processes and introduces new rules aimed at increasing

the effectiveness of risk oversight by Boards, improving the status of the risk management function and ensuring effective monitoring by supervisors of risk governance.

- diversity: CRD IV introduces a number of requirements aiming at diversity in board composition which should contribute to effective risk oversight by boards, providing for a broader range of views and opinion and therefore avoiding the phenomenon of group think.
- enhanced transparency for regaining the trust of the public in the financial sector: CRD IV improves transparency regarding the activities of banks and investment funds in different countries, in particular as regards profits, taxes and subsidies in different jurisdictions.
- systemic risk buffer: Each Member State may introduce a Systemic Risk Buffer of Common Equity Tier 1 for the financial sector or one or more subsets of the sector, in order to prevent and mitigate long term non-cyclical systemic or macro-prudential risks with the potential of serious negative consequences to the financial system and the real economy in a specific Member State.
- other systemic institution buffer: In addition to the mandatory G-SII buffer, the CRD IV provides for a supervisory option for a buffer on "other" systemically important institutions. This includes domestically important institutions as well as EU important institutions.

In the regulation, a single set of harmonised prudential rules is created for the first time. This ensures uniform application of Basel III in all Member States which closes regulatory loopholes and thus contributes to proper functioning of the Internal Market. The new rules remove a large number of national options and discretions and allow the Member States to apply stricter requirements only when justified by national circumstances (e.g. real estate), needed on financial stability grounds or because of a bank's specific risk profile (EC, 2013).

In 2019, the CRR/CRD IV package was updated. The CRD V (EU Directive 2019/878) aims to address issues raised in relation to the provisions of CRD IV that proved not to be sufficiently clear and have, therefore, been subject to divergent interpretations or that have been found to be overly burdensome for certain institutions. It also contains adjustments to CRD IV that are necessary following either the adoption of other relevant Union legal acts or the changes proposed in parallel to the CRR. Finally,

the amendments better align the current regulatory framework to international developments to promote consistency and comparability among jurisdictions.

The Basel III reforms implemented by CRR II (Regulation (EU) 2019/876) and CRD V include an overhaul of the market risk regime, new capital rules for derivatives and securities financing transactions, a binding leverage ratio and supplemental leverage requirement for global systemically important banks (G-SIBs), a net stable funding liquidity ratio (NSFR) and rules on total loss absorbing capacity (TLAC) for G-SIBs (Council of the EU, 2019). In addition to the Basel III prudential reforms, the measures contain a number of further changes including:

- a new authorisation and supervision regime for financial holding companies;
- a new requirement for third country banking groups with significant activity in the EU to establish an EU intermediate parent undertaking (IPU);
- amendments to Pillar 2 capital rules;
- amendments to large exposure rules;
- new remuneration requirements;
- proportionality requirements.

Some provisions of the CRR II (e.g. definitions, provisions on massive disposals, certain provisions on own funds requirements for central counterparties and TLAC) apply from 27 June 2019, when the CRD V/CRR II package entered into force. Member States have to transpose the CRD V to their national legislation until 28 December 2020. From this date, some CRR II provisions will apply (e.g. provisions on exposures secured by mortgages on immovable property). The main application date for CRR II is 28 June 2021.

3.2.4 Macroprudential policy frameworks in analysed countries

A well-defined policy framework is necessary for effective conduct of macroprudential policy. Since the responsibility for the adoption of measures necessary to maintain financial stability lies first within national frameworks, effectiveness of national macroprudential policy frameworks is important (ESRB/2011/3). National macroprudential authorities are responsible for identifying, monitoring and assessing risks to financial stability and of implementing macroprudential policies (ESRB/2011/3). National designated authority is responsible for setting the countercyclical buffer rate for

that Member State (Directive 2013/36/EU). According to ESRB (2019), there are two approaches to macroprudential policy among the analysed panel of countries:

- integrated approach: the role of macroprudential authority and the role of designated authority are undertaken by the same institution(s);
- separated approach: the role of macroprudential authority and the role of designated authority are undertaken by different institutions.

Macroprudential authority and designated authority roles are undertaken by the same institution in Belgium, Finland, France, Greece, Ireland, Italy and Portugal. The institutional setups are as follows:

- Belgium: The National Bank of Belgium (NBB) is in charge of macroprudential supervision and also has special powers in relations to systemic institutions (NBB, 2017). Its macroprudential powers were further extended by the macroprudential law and the new Belgian Banking law in 2014, as it designated NBB as the macroprudential authority.
- Finland: The Finnish Financial Supervisory Authority (FIN-FSA) is responsible for taking macroprudential policy decisions and also serves as the authority for supervision of Finland's financial and insurance sectors (FIN-FSA, 2020). FIN-FSA is independent of the Bank of Finland.
- France: The High Council for Financial Stability (HCSF) supervises the financial system as a whole to ensure its stability and its sustainable contribution to economic growth. The council has eight members – the French Minister of the Economy and Finance (chair), Governor of the Banque de France, Vice-Chairman of ACPR[12], the Chairman of AMF[13], the Chairman of ANC[14] and three external members (IMF, 2019).
- Greece: The Bank of Greece exercises macroprudential tasks with a view to strengthening the resilience of the financial system and decreasing the build-up of systemic risks, conducts prudential supervision and is responsible for setting the countercyclical capital buffer rate (Bank of Greece, 2016).

[12] ACPR is an abbreviation for the French Prudential Supervisory and Resolution Authority (Autorité de contrôle prudentiel et de résolution).
[13] AMF is an abbreviation for the French Financial Markets Authority (Autorité des marchés financiers).
[14] ANC is an abbreviation for the French Accounting Standards Authority (Autorité des normes comptables).

- Ireland: The Central Bank of Ireland has a wide range of macroprudential powers that derive from both European and Irish law, including implementation of macroprudential policy instruments and prudential supervision (Central Bank of Ireland, 2014).
- Italy: The Bank of Italy performs its tasks of safeguarding financial stability through intense analysis and supervision of the financial system's single components and of the system as a whole, in order to promptly identify vulnerabilities and risks for financial stability (Bank of Italy, 2020). The powers to set up a macroprudential authority were granted in 2016, but have since expired, leaving the Bank of Italy responsible for addressing financial stability concerns (ESRB, 2019).
- Portugal: Banco de Portugal defines and executes macroprudential policy through macroprudential instruments, orders, warnings and recommendations to promote the financial system's resilience in absorbing risks, ensuring adequate levels of financial intermediation and thus contributing to sustainable economic growth (Banco de Portugal, 2020).

Macroprudential authority and designated authority are different institutions in Austria, Germany, Luxembourg, the Netherlands and Spain. The countries have following frameworks:

- Austria: The Financial Market Stability Board (FMSB) is the macroprudential authority which addresses risks to financial stability and issues recommendations for further actions (FMSB, 2020). The work of FMSB is linked to the Oesterechische Nationalbank (OeNB) which is responsible for macroprudential monitoring and to the Financial Market Authority (FMA) which is an integrated supervisory authority as well as the designed authority (FMA, 2020; OeNB, 2020b).
- Germany: The Financial Stability Committee serves as the macroprudential authority, as it examines issues relevant to financial stability in Germany, identifies potential risks, issues warnings and present recommendations on how to avert the risks (Federal Ministry of Finance, 2020). It comprises of representatives of the Federal Ministry of Finance (one of them is a chair), Deutsche Bundesbank and Federal Financial Supervisory Authority (BaFin). The Federal Financial Supervisory Authority is a designated authority responsible for supervision in the financial sector (ESRB, 2019).

- Luxembourg: The Systemic Risk Committee (CdRS) coordinates macroprudential policy in Luxembourg. The committee comprises of the Finance Minister, Director General of the BCL[15], Director General of the CSSF and Director of CAA[16] (IMF, 2017d). The Financial Supervisory Authority (CSSF) is the national designed authority responsible for implementing macroprudential supervision and policy for Luxembourg banks (CSSF, 2020).
- Netherlands: The Financial Stability Committee (FSC) is the national macroprudential authority whose members include representatives of De Nederlandsche Bank (DNB), Ministry of Finance (MoF) and Authority for the Financial Markets. The FSC issues warnings and makes recommendations to mitigate risks (without a comply-or-explain mechanism), but the use of macroprudential instruments remains the responsibility of individual agencies, the DNB and the MoF (IMF, 2017b). The DNB conducts macro- and microprudential policies as the National Designated and Competent Authority (IMF, 2017b)
- Spain: The Macroprudential Authority Financial Stability Council (AMCESFI) monitors and analyses sources of systemic risk to issue warning, recommendations and opinions on matters pertaining to financial stability (BdE, 2020a). AMCESFI pursue the objective of financial stability in cooperation with sectoral authorities; however, each of the sectoral authorities retains its supervisory competences, including the power to adopt macroprudential tools (ECB, 2019c). Banco de España serves as national designated authority for the preparation, decision and implementation of macroprudential measures applicable to credit institutions (BdE, 2020b).

3.3 Monetary policy in the euro area

The agreement to form a European monetary union was formalised in the Treaty of Maastricht, which was signed in 1992 (Cecchetti and Schoenholz, 2011). In 1999, the ECB assumed responsibility for monetary policy in the euro area which means that a member of the euro area is not able to use domestic interest and exchange rate policies as separate policy instruments (ECB, 2011d).

[15] BCL is an abbreviation for the Banque Centrale du Luxembourg.
[16] CAA is an abbreviation for Commissariat aux Assurances.

3.3.1 Institutional framework of the single monetary policy

The legal basis for the single monetary policy is laid down in the Treaty on European Union (TEU), the Treaty on the Functioning of the European Union (TFEU), and the Statute of the European System of Central Banks and of the European Central Bank (the Statute of the ESCB). The Treaties and the Statute of the ESCB, which is annexed to the Treaties as a protocol, establish the ECB, the Eurosystem and the ESCB.

According to Article 13 of the TEU, the **European Central Bank** (ECB) is an institution of the EU. The ECB is responsible for the prudential supervision of credit institutions located in the euro area and participating non-euro area Member States within the SSM which also comprises the national competent authorities (ECB, 2020l). It thereby contributes to the safety and soundness of the banking system and the stability of the financial system within the EU and each participating Member State. The main bodies of the ECB are:

- **the Executive Board:** The Executive Board of the ECB comprises the President, the Vice-President and four other members[17] who are all appointed by the European Council and oversees the operation of the ECB and the Eurosystem (ECB, 2020e). It is responsible for preparing the Governing Council meetings, implementing monetary policy for the euro area by giving instructions to the central banks in the euro area, managing the day-to-day operations of the ECB and exercising powers delegated to it by the Governing Council (ECB, 2020e).
- **the Governing Council:** The Governing Council is the highest decision-making body of the ECB. It is composed of the six Executive Board members and governors of the central banks in the euro area[18] (Cecchetti and Schoenholz, 2011). The Council is responsible for adoption of guidelines and decisions ensuring the well-functioning of the ECB and the Eurosystem, formulation of monetary policy (decisions related to monetary objectives, key interest rates, the supply of reserves in the Eurosystem) and adoption of decisions related to o the general framework under which supervisory decisions are taken (ECB, 2020g).

[17] All Executive Board members are appointed for an eight-year term that cannot be renewed. Currently, the members of the Executive Board are Christine Lagarde (President of the ECB), Luis de Guindos (Vice-President of the ECB), Fabio Panetta, Yves Mersch, Isabel Schnabel and Philip R. Lane.

[18] In the Governing Council, rotation system of voting rights is implemented. The Executive Board members hold permanent voting rights, governors from DE, FR, IT, ES and NL share four voting rights and all others (14 as of 2020) share 11 voting rights (ECB, 2014). The Governors take turns using the rights on a monthly rotation.

- **the General Council:** The General Council comprises the President and the Vice-President of the ECB and the governors of the national central banks (NCBs) of all EU Member States. It issues decisions, recommendations and opinions (ECB, 2020f). In accordance with the Statute of the ESCB, the General Council will be dissolved when all EU Member States have introduced the single currency.
- **the Supervisory Board:** The Supervisory Board is composed of a chair, a vice-chair, four ECB representatives and representatives of national supervisory authorities in the euro area and is responsible for discussion, planning and implementation of the ECB's supervisory tasks (ECB, 2020j). The Supervisory Board meetings are prepared by the Steering Committee comprised of the chair and vice-chair of the Supervisory Board, one ECB representative and five representatives of national supervisors[19] (ECB, 2020j).

The **Eurosystem** is made up of the ECB and the NCBs of the EU Member States whose currency is the euro (Cecchetti and Schoenholz, 2011). The primary objective of Eurosystem is the maintenance of price stability for the common good: safeguarding the value of the euro (ECB, 2020d). The Eurosystem is responsible for:

- defining and implementing monetary policy in the euro area;
- conducting foreign exchange operations;
- holding and managing the euro area's reserves of foreign currency;
- promoting the smooth functioning of payment systems (ECB, 2020d).

Acting also as a leading financial authority, Eurosystem aims to safeguard financial stability and promote European financial integration.

According to Article 282(1) of the TFEU, the **European System of Central Banks** (ESCB) is established. It comprises the ECB and the NCBs of all EU Member States. It is governed by the decision-making bodies of the ECB and its main objective. As long as there are EU Member States whose currency is not the euro, it will be necessary to make a distinction between the Eurosystem and the ESCB (ECB, 2011d). Under the TFEU, the tasks to be carried out through the ESCB are:

- defining and implementing the monetary policy of the Union,
- conducting foreign exchange operations,

[19] The five representatives of national supervisors are appointed by the Supervisory Board for one year based on a rotation system that ensures a fair representation of countries.

- holding and managing the official foreign reserves of the Member States,
- promoting the smooth operation of payment systems of the Member States.

The ESCB supports the general economic policies in the EU, aiming to promoting a harmonious and balanced development of economic activities, sustainable and non-inflationary growth which respects the environment, a high degree of convergence of economic performance and a high level of employment and social protection by establishing a common market, an economic and monetary union and by implementing the common policies and activities (ECB, 2011d).

3.3.2 The monetary policy strategy of the European Central Bank

The ECB has adopted a monetary policy strategy[20] to ensure a consistent and systematic approach to its monetary policy decisions. The strategy embodies five general principles to meet the challenges which the ECB is facing while making decisions on the appropriate level of short-term interest rates and explaining such decisions to the public.

First, proper functioning of the money market is central to the transmission of the ECB's policy rates. The smooth transmission of the Governing Council's monetary policy intentions to money market rates depends critically on the behaviour of banks and on their willingness to entertain smooth exchanges of liquidity in the interbank market (ECB, 2011d). Dysfunctional money markets can limit the capacity of monetary policy to influence the outlook for price stability through interest rate adjustments. To keep the transmission mechanism fully operational and to ensure the maintenance of price stability over the medium term, the ECB may need to employ non-standard policy measures, i.e. liquidity interventions aimed at facilitating the transmission of the interest rate policy and enhancing the flows of credit to the broad economy (ECB, 2011d).

Second, changes in monetary policy will affect the price level after a number of quarters or years due to the lacks and stochastic uncertainty in the transmission process (ECB, 2011d). This means that the ECB needs to figure out what policy stance is needed today in order to maintain price stability in the future, after the transmission lags unwind. In this sense, the single monetary policy in the euro area must be forward-looking and pre-emptive.

Third, transmission lags cause that monetary policy is not able to offset unanticipated shocks in the short run, thus some short-term volatility in inflation rates is

[20] The monetary policy strategy was adopted in 1998 and further clarified in 2003.

unavoidable (ECB, 2011d). Moreover, the complexity of the transmission process is followed by uncertainty which surrounds the monetary policy effects. Therefore, monetary policy should be oriented on the medium term to avoid excessive activism and the introduction of unnecessary volatility into the real economy.

Fourth, monetary policy will be considerably more effective if it firmly anchors inflation expectations. In this respect, the ECB should specify its goal, elaborate and keep to a consistent and systematic method for conducting monetary policy, and communicate clearly and openly (ECB, 2011d). These are key elements for acquiring a high level of credibility, a necessary precondition for influencing the expectations of economic actors.

Finally, a successful monetary policy has to be broadly based, taking into account all relevant information in order to understand the factors driving economic developments, and cannot rely on a single model of the economy (ECB, 2011d). The reasoning behind is that the ECB faces considerable uncertainty about the reliability of economic indicators, the structure of the euro area economy and the monetary policy transmission mechanism, as well as other challenges.

The monetary strategy of the ECB comprises two main elements:

- **the quantitative definition of price stability**: Price stability shall be defined as a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below, but close to, 2% over the medium term (ECB, 2011d).
- **the two-pillar approach to analysis of the risks to price stability**: Economic analysis and monetary analysis form the basis for the Governing Council's monetary policy decisions. The economic analysis aims at assessing short to medium-term determinants of price developments, while the monetary analysis focuses on a medium to longer-term horizon of the link between money and prices (ECB, 2011d).

In the beginning of 2020, the Governing Council launched a review of the ECB's monetary strategy which is expected to be concluded by the end of the year. The review will encompass quantitative formulation of price stability, monetary policy toolkit, economic and monetary analyses and communication practices based on thorough analysis and engagement with all stakeholders (ECB, 2020b).

3.3.3 Implementation of monetary policy in the euro area

The operational framework of the Eurosystem consists of the following set of instruments: open market operations, standing facilities and minimum reserve

requirements for credit institutions (ECB, 2020m). Furthermore, the ECB has implemented non-standard monetary policy measures to complement the regular operations of the Eurosystem and to react to the economic developments and outlooks.

Open market operations are the most important operations in steering interest rates, managing the liquidity situation in the market and signalling the monetary policy stance (ECB, 2011d). There are four types of open market operations:

- main refinancing operations (MROs): MROs are the most important open market operations and represent the key monetary policy instrument of the Eurosystem. Through MROs, the Eurosystem lends funds to its counterparties against adequate collateral (ECB, 2011d).
- longer-term refinancing operations (LTROs): LTROs are aimed at providing counterparties with additional longer-term refinancing and can also serve other monetary policy objectives (ECB, 2020m). Regular LTROs have a maturity of three months but the Eurosystem may also conduct non-regular operations with maturities of up to 48 months.
- fine-tuning operations (FTOs): FTOs are aimed at smoothing the effects on interest rates caused by unexpected fluctuations in the liquidity. FTOs are primarily reverse transactions but may also be implemented as foreign exchange swaps or the collection of fixed-term deposits (ECB, 2020m).
- structural operations: Structural operations are executed when the ECB wishes to adjust the structural position of the Eurosystem vis-à-vis the financial sector (on a regular or non-regular basis). They can be carried through reverse transactions, outright transactions, and the issuance of debt certificates (ECB, 2020m).

Standing facilities provide and absorb overnight liquidity, signal the general monetary policy stance and bound overnight market interest rates (ECB, 2020i). The Eurosystem offers two standing facilities to credit institutions:

- marginal lending facility: Counterparties may use the marginal lending facility to obtain overnight liquidity from the Eurosystem through a reverse transaction with their home NCB at a pre-specified interest rate using eligible assets as collateral (ECB/2014/60).

- deposit facility: Counterparties may use the deposit facility to make overnight deposits with the Eurosystem through the home NCB, to which a pre-specified interest rate shall be applied.

The **minimum reserve system** aims at stabilising money market interest rates and creating or enlarging a shortage in structural liquidity (ECB, 2011d). In other words, banks in the euro area are required to hold a certain amount of funds as reserves in their current accounts at their NCB. A bank's minimum reserve requirement is defined for six-week maintenance periods and the level is calculated on the basis of the bank's balance sheet before the start of the maintenance period (ECB, 2016c). Until January 2012, banks had to hold a minimum of 2% of certain liabilities, mainly customers' deposits, at their NCB; however, since then, this ratio has been lowered to 1% (ECB, 2016c).

Since the onset of the financial crisis, the ECB has complemented its operating framework with **non-standard monetary policy measures**. This has included:

- fixed-rate full allotment: In autumn 2008, the ECB provided unlimited credit to banks at fixed interest rates, as banks could not rely on borrowing from each other (ECB, 2020h).
- Securities Markets Programme (SMP): The SMP from 2010 involved the purchase of debt securities by the Eurosystem from its counterparts which intended to ensure depth and liquidity in malfunctioning segments of the debt securities markets and to restore an appropriate functioning of the monetary policy transmission mechanism (ECB, 2010).
- very long-term refinancing operations (VLTROs): In 2011, the Governing Council has decided to conduct two VLTROs with a maturity of 36 months and the option of early repayment after one year (ECB, 2011a).
- Outright Monetary Transactions (OMTs): Launched in 2012, OMTs aimed at safeguarding the transmission mechanism in all euro area countries and the singleness of the monetary policy (ECB, 2012b). They break the circuit against self-reinforcing fears in sovereign bond markets.
- a negative interest rate in the deposit facility: The ECB introduced a negative interest rate, as the inflation is expected to remain considerably below 2% for a prolonged period (ECB, 2014b).

- targeted longer-term refinancing operations (TLTROs): TLTROs are Eurosystem operations that provide financing to credit institutions. By offering banks long-term funding at attractive conditions they preserve favourable borrowing conditions for banks and stimulate bank lending to the real economy (ECB, 2020k). A first series of TLTROs was announced on 5 June 2014, a second series (TLTRO II) on 10 March 2016 and a third series (TLTRO III) on 7 March 2019.
- an asset purchase programme (APP): APP was initiated in mid-2014 to support the monetary policy transmission mechanism and provide the amount of policy accommodation needed to ensure price stability (ECB, 2020a). Asset purchases of the ECB influence broader financial conditions (and eventually economic growth and inflation) through direct pass-through, portfolio rebalancing and signalling effect (ECB, 2019b).
- forward guidance: The ECB provides information about its future monetary policy intentions, based on assessment of the outlook for price stability (ECB, 2017b). Clear communication about future monetary policy intentions helps banks, financial market participants, businesses and consumers to better understand of how borrowing costs are likely to develop in the future.

3.3.4 Conduct of monetary policy in the euro area

The Governing Council of the ECB (2020g) sets three key interest rates:

- **main refinancing operations rate:** In these operations, banks can borrow liquidity from the Eurosystem against collateral on a weekly basis, at a pre-determined interest rate. From September 2019, the main refinancing operations rate is 0% (ECB, 2020h).
- **deposit facility rate:** Deposit facilities are used to make overnight deposits with the Eurosystem at a (pre-set) rate lower than the main refinancing operations rate. From September 2019, the marginal lending facility rate is -0.5% (ECB, 2020h).
- **marginal lending facility rate:** Marginal lending facility offers overnight credit to banks from the Eurosystem at a pre-set interest rate which is higher than the main refinancing operations rate. From September 2019, the marginal lending facility rate is 0.25% (ECB, 2020h).

The deposit facility rate and the marginal lending facility rate (**Figure 3.1**) define a corridor for the overnight interest rate at which banks lend to each other. In other words,

the deposit facility rate acts as the floor of this corridor and the marginal lending facility acts as the ceiling.

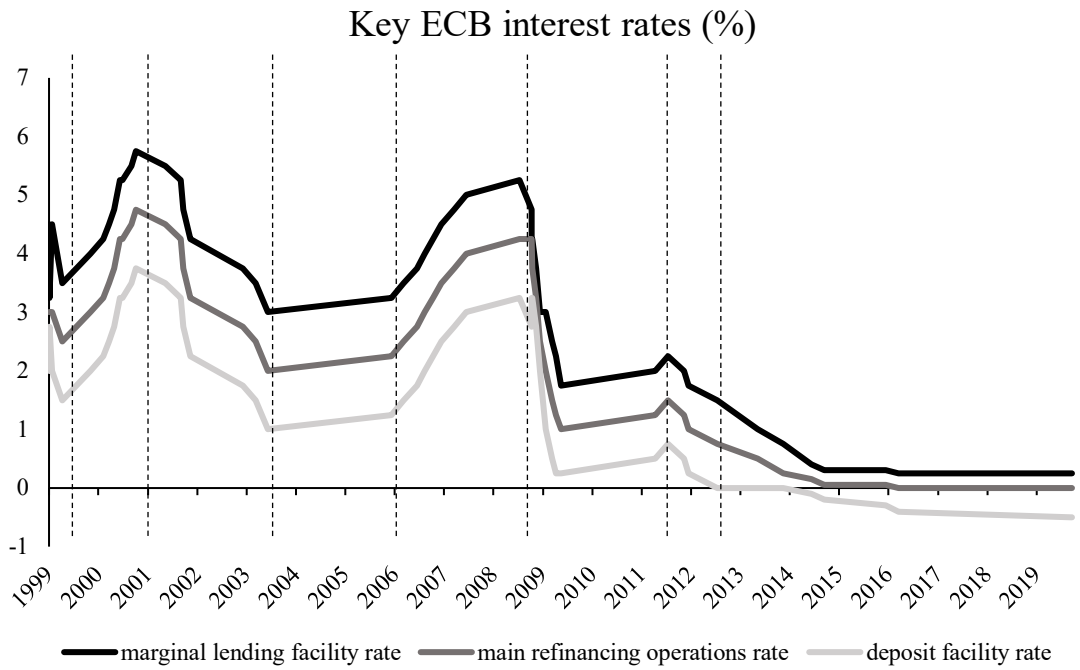


Figure 3.1: The phases of the ECB's monetary policy

Source: ECB, 2020h (own elaboration)

In the conduct of monetary policy in the euro area, eight phases can be distinguished (see Figure 3.1):

- **first phase – transition to monetary union (mid-1998 to mid-1999):** In this phase, the responsibility for monetary policy was transferred to the ECB. In response to downward risks to price stability, the Governing Council lowered the ECB's main refinancing rate by 50 basis points to 2.5% in April 1999 (ECB, 2011d).
- **second phase – rates raised to contain inflationary pressures (mid-1999 to end-2000):** In this phase, there were increasing concerns that inflationary pressures from import prices could have broadly based second-round effects via wage and price-setting behaviour, and might thus lead to an increase in the long-term inflation expectations of the public at large and another cause for concern was the progressive accumulation of liquidity, as indicated by the protracted expansion of the supply of money and credit (ECB, 2011d).
- **third phase – downward adjustments to key ECB interest rates (early 2001 to mid-2003):** Over this period, there was continued decline in inflationary pressures which had been triggered mainly by deteriorating prospects for economic growth in

the wake of severe shocks that had hit the world economy and global financial markets (ECB, 2011d). Therefore, key ECB interest rates were reduced.

- **fourth phase – no changes to key ECB interest rates (mid-2003 to end-2005):** Contained price pressures despite large increases in commodity and energy prices, as well as rises in indirect taxes and administered prices caused the Governing Council to keep ECB interest rates unchanged until end-2005 (ECB, 2011d).
- **fifth phase – withdrawal of monetary accommodation (end-2005 to mid-2008):** The interest rates were raised to address upside risks to price stability in a setting of sound economic growth and a rapid expansion of the supply of money and credit in the euro area (ECB, 2011d).
- **sixth phase – the ECB's response to the financial crisis (autumn 2008 to early-2011):** The ECB, like other major central banks, reduced its key interest rates to historically low levels and embarked on a series of non-standard policy measures, with a view to preserving price stability, stabilising the financial situation and limiting contagion vis-à-vis the real economy (ECB, 2011c).
- **seventh phase – volatilities in recovery from the financial crisis (mid-2011 to mid-2012):** From April to July 2011, the Governing Council decided to increase the key interest rates, after maintaining them unchanged for almost two years at historically low levels, because underlying pace of monetary expansion was continuing to gradually recover, while monetary liquidity remained ample with the potential to accommodate price pressures in the euro area. (ECB, 2011d). In November of the same year, the rates were reduced, because inflation was expected to decline further in the course of 2012 to below 2% (ECB, 2011b). After that, further reductions were implemented, and the deposit facility rate reached zero in July 2012.
- **eighth phase – from zero to negative deposit facility rate (since mid-2012):** In July 2012, the key interest rates were lowered again, causing the deposit facility rate to be 0%. Inflationary pressure over the policy-relevant horizon had been dampened further as some of the previously identified downside had materialised, and at the same time, economic growth in the euro area continued to remain weak, with heightened uncertainty weighing on confidence and sentiment (ECB, 2012a). In 2014, the deposit facility rate was lowered to -0,1%, encouraging people to spend and invest rather than save (ECB, 2014b). The lowering has continued and as of 2019, all key interest rates are at their historical minimums.

3.4 Institutional setup in macroprudential policy and monetary policy

In the literature, there is no consensus on whether the monetary policy and the banking regulation and supervisory functions should be combined in a central bank or performed by separate institutions. An argument for combining the monetary and regulatory functions is the central bank's objective of preventing contagious systemic crises (Goodhart and Schoenmaker, 1995). Central banks are suitable as macroprudential regulators, as they are ideally positioned to monitor macroeconomic developments and the potential implications of monetary policy decisions for leverage and risk taking also favour the centralization of macroprudential responsibilities within the central bank (Blanchard et al., 2010). The main case usually presented for separation is on grounds of conflict of interest (Goodhart and Schoenmaker, 1995). Moreover, the central bank may tend to a "softer" stance against inflation, since interest rate hikes may have a detrimental effect on bank balance sheets (Blanchard et al., 2010).

In the analysed panel of countries, there are four approaches to the institutional setup of macroprudential policy and monetary policy:

- **all responsibilities are given to the NCB:** In this case, the central bank has a triple role: it acts as a macroprudential authority, a designed authority and is a part of Eurosystem. This is the case of Belgium, Greece, Italy, Ireland and Portugal.
- **macroprudential authority is separate and the NCB is also a designated authority:** In this case, implementation of macroprudential policy is independent of supervision and monetary policy which are under the NCB. This is the case of the Netherlands and Spain.
- **macroprudential and designed authority is one institution separate from the NCB:** In this case, implementation and supervision of macroprudential policy is under an institution outside of the NCB. This is the case of Finland and France.
- **macroprudential authority, designed authority and the NCB are separate:** In this case, the responsibilities are divided in three institutions. This is the case of Austria, Germany and Luxembourg.

3.5 Data on analysed phenomena

This sub-chapter describes the data on financial development, economic growth, macroprudential and monetary policy, the process of gathering it and (if applicable) the process of raw data transformation.

3.5.1 Financial development data

One of the recognised measures of financial development is the Financial Development Index (FDI) which can be used for cross-country comparison and benchmarking. Svirydzenka (2016) constructed the Financial Development Index from a total of nine indices and twenty indicators (see Table 3.1).

CATEGORY	INDICATOR
Financial Institutions	
Depth	Private-sector credit to GDP
	Pension fund assets to GDP
	Mutual fund assets to GDP
	Insurance premiums (life and non-life) to GDP
Access	Bank branches per 100 000 adults
	ATMs per 100 000 adults
Efficiency	Net interest margin
	Lending-deposits spread
	Non-interest income to total income
	Overhead costs to total assets
	Return on assets
	Return on equity
Financial Markets	
Depth	Stock market capitalisation to GDP
	Stocks traded to GDP
	International debt securities of government to GDP
	Total debt securities of financial corporations to GDP
	Total debt securities of non-financial corporations to GDP
Access	Percent of market capitalisation outside of top 10 largest companies
	Total number of issuers of debt (domestic and external, non-financial and financial corporations)
Efficiency	Stock market turnover ratio (stocks traded to capitalisation)

Table 3.1: Indicators used in the financial development index

Source: Svirydzenka (2016) (own elaboration)

The financial development index contains data from 1980 to 2017 and ranges from 0 to 1, the higher the number, the more financially developed country. In my research, I use the aggregated index and the sub-indices measuring overall development of financial institutions and financial markets. To improve usability of this indicator in my research, I multiplied the raw data values by 100, as the transformed data enabled me to better track first differences which I used in my model. Overall, financial development has progressed quite noticeably in my sample of countries (**Figure 3.2**). From the beginning of the European Monetary Union in 1999, the average value was increasing until the global financial crisis in 2008, which had its toll on some of the indicators. When I look at

the sub-indices (**Figures 3.3A and 3.3B**), they show that in my panel of countries, the development of financial institutions is more uniform than the development of financial markets. However, if I look on the data from 1999, the financial markets development is more uniform than in the pre-monetary union period. The data also show that the markets were affected by the crisis more than the institutions.

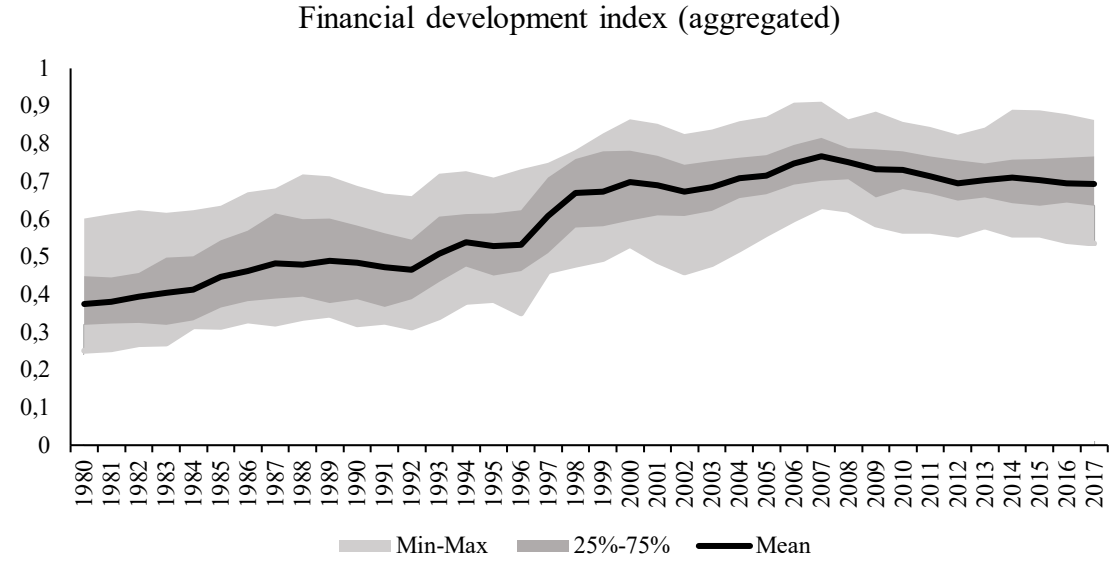


Figure 3.2: Analysis of financial development index

Source: Svirydzenka (2016) (own elaboration)

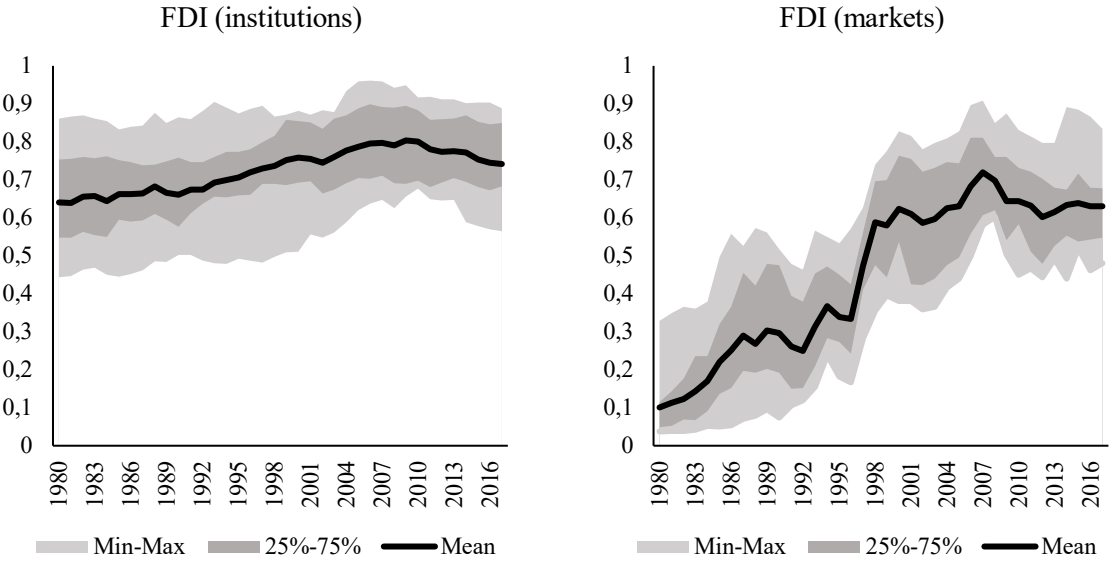


Figure 3.3A and 3.3B: Sub-indices of financial development

Source: Svirydzenka (2016) (own elaboration)

3.5.2 Macroprudential policy data

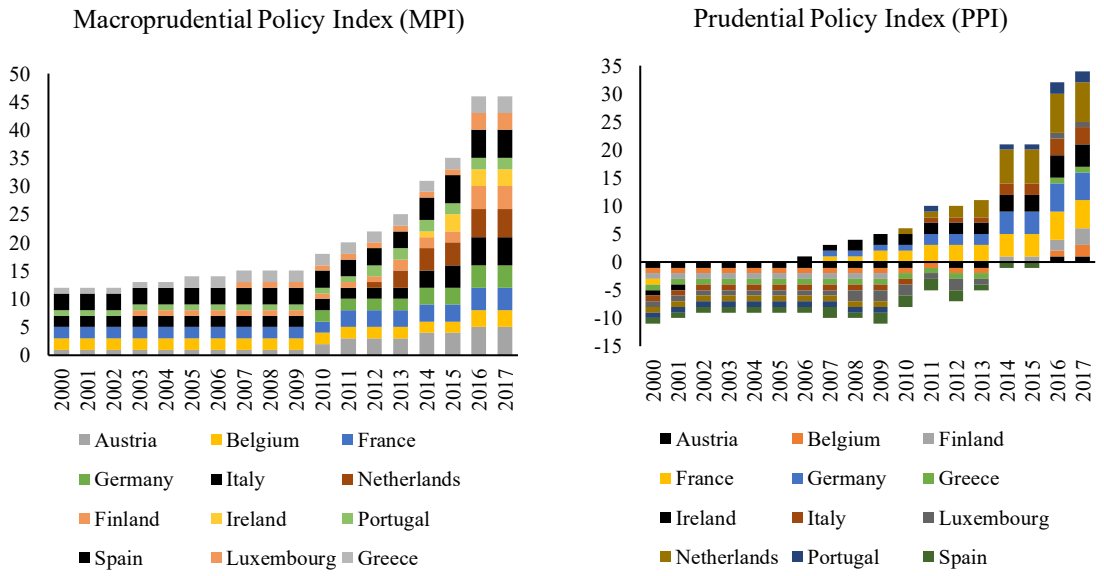
For capturing the macroprudential policy, I use two indices: the Macroprudential Policy Index constructed by Cerutti et al. (2015) and the Prudential Policy Index from

Cerutti et al. (2017). The first index captures number of implemented macroprudential policy instruments and the second one also takes into account the effect of such instruments. Both indices are of a dummy type, so they account for number of employed macroprudential policy instruments. In addition, the second index includes the direction of policy changes (but not the intensity of the change).

The Macroprudential Policy Index (henceforth MPI) contains 12 macroprudential policy instruments as simple binary variables (**Figure 3.4A**). The macroprudential instruments covered are: general countercyclical capital buffer/requirement, leverage ratio for banks, time-varying/dynamic loan-loss provisioning, caps on the loan-to-value ratio, debt-to-income ratio, limits on domestic currency loans, limits on foreign currency loans, reserve requirement ratios in foreign currency, levy/tax on financial institutions, capital surcharges on systemically important financial institutions, limits on interbank exposures and concentration limits. The index for each of the employed instruments takes the value of 1 if it is active and the value of 0 if it is inactive. An overall macroprudential index is calculated cumulatively, as the simple sum of the scores for all instruments. MPI does not take into account the effect of the instruments (whether the policy is tightening or loosening).

The Prudential Policy Index (henceforth PPI) comprises actions of (micro- and macro-) prudential nature and records changes including their effect (**Figure 3.4B**). It covers nine types of prudential instruments (general capital requirements, real estate credit related specific capital buffers, consumer credit related specific capital buffers, other specific capital buffers, domestic currency capital requirements, foreign currency capital requirements, interbank exposure limits, concentration limits and loan-to-value (LTV) ratio limits. In PPI, an instrument has a 1 or -1 entry, depending on whether the prudential tool was tightened or loosened in a given quarter (Cerutti et al., 2017). The index equals 0 in those quarters when no change occurs. As mentioned before, the data are on a quarterly basis, so I calculated an average for each year for the cumulative PPI where all individual instruments are adjusted to have maximum and minimum changes of 1 and -1. Since the ready-to-use data ends in 2014, I appended the PPI based on data from Budnik and Kleibl (2018) and ESRB (2020d) following the methodology of the original index.

The two indices show that the frequency of use of macroprudential policy instruments is growing in time. Furthermore, the nature of the policies shifted from loosening in the beginning of the sample to tightening at the end of the sample. As of 2017, all instruments implemented in the panel of countries were of a tightening nature.



Figures 3.4A and 3.4B: Evolution of prudential measures

Source: Cerutti et al., 2018 (left-hand graph) and Cerutti et al., 2017 (right-hand graph) (own elaboration)

3.5.3 Economic growth data

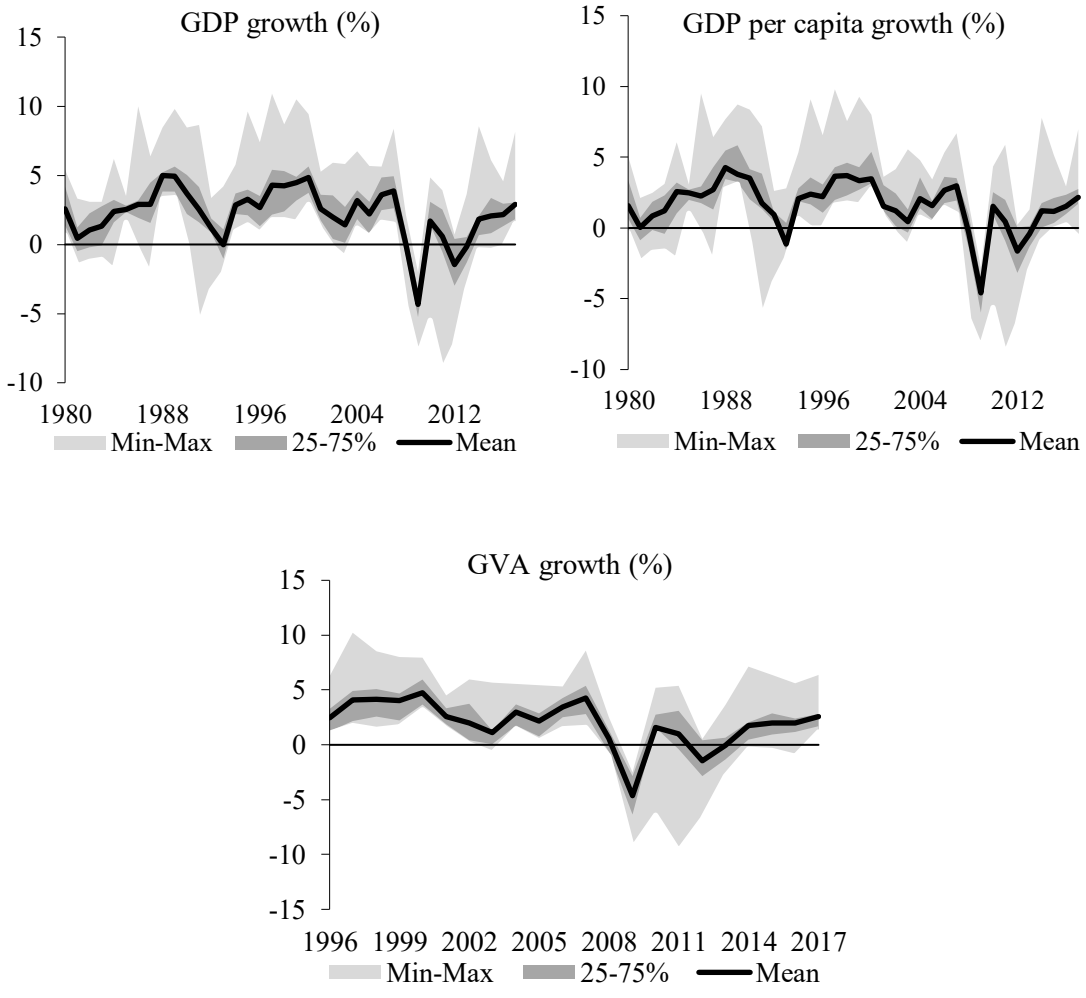
In my research, I work with three indicators that capture economic growth: gross domestic product (GDP), GDP per capita and gross value added (GVA). The data on all variables are seasonally adjusted.

For GDP, the data on its growth is available from 1980 to 2017 on an annual basis. **Figures 3.5A** (GDP growth) **and 3.5B (**GDP per capita growth) shows the minimum-maximum and first quartile-third quartile intervals together with mean (average of the values for each year). In 1991, the minimum takes an extreme value, as Finland went through a banking crisis which had negative impacts on economic growth. In 1993, the mean took a negative value, because eight countries of the sample observed negative growth rate, but they were able to recover the following year. The Figures also show how the crisis affected the growth rates and how the countries in my panel were affected differently (most were able to recover in few years, Greece observed positive growth rate only in 2017). The data for GVA are available on an annual basis from 1996 to 2017. For GVA (**Figure 3.5C**), the development is somehow uniform until the 2008 financial crisis.

The extreme negative values are from 2009 (Finland's GVA was -9% at that time) and 2011 when Greece had -9% growth rate as well.

In all three datasets, there was one extreme value which belongs to Ireland in 2015. The main reason behind the particularly high growth rates was a massive relocation of large multinational companies to Ireland, which caused that sales (production) generated from the use of intellectual property now contribute to Irish GDP rather than to other countries' GDP (OECD, 2016). Therefore, I removed these values and used interpolation to calculate the missing data by using the following equation for each of the variables:

$$value_{2015} = \frac{value_{2014} + value_{2013}}{2} \tag{3.1}$$



Figures 3.5A, 3.5B and 3.5C: Analysis of economic growth data

Source: The World Bank, 2020b-c (GDP and GDP per capita growth); WIIW, 2020 (GVA growth) (own elaboration)

3.5.4 Monetary policy data

As mentioned in previous chapters, the choice of my sample was motivated by the fact that the countries share common monetary policy. I employ two indicators which capture monetary policy in the panel of analysed countries – the Euro Interbank Offered Rate (EURIBOR) and Monetary Conditions Index (MCI).

Earlier, monetary aggregates were used to indicate monetary policy stance; however, since money is endogenous, their use is no longer justified (Friedman and Schwartz, 1963; Cagan, 1972). Bernanke and Blinder (1992) use the interest rate set by the central bank (or the inter-bank rate) as the indicator of monetary policy measures. An alternative to the interest/inter-bank rate is a composite indicator as a combination of variables describing monetary policy and the monetary stance.

EURIBOR is the rate at which banks in the EU and European Free Trade Association (EFTA) could obtain funds in the wholesale unsecured market (ECB, 2019d). It is calculated for several maturities (one week, and one, three, six and twelve months). I use the three-month EURIBOR rate which has available data from 1995, transforming the raw monthly data to annual data by averaging them for each year.

The MCI from Hodula (2019) captures the effect of conventional and unconventional monetary policies and is calculated from the set of 14 variables which reflect interest rates, monetary aggregates, ECB balance sheet items and exchange rate. The MCI is similar to that obtained by Babecká Kucharčuková et al. (2016) and Malovaná and Frait (2017). The data are available on a monthly basis from 2000, for my model, I calculate the annual values as averages of the monthly data for each year.

In **Figure 3.3**, I plot the two chosen indicators of monetary policy against the main ECB rates. The MCI is in line with the path of main ECB monetary policy rates, mainly prior and during the financial crisis. In 2011, the MCI starts to deviate from the policy rates, as the ECB started with non-standard monetary policy measures to support the euro area economy. Since 2014, MCI indicates loosening of monetary policy related to the Securities Market Programme and long-term refinancing operations programme. The launch of Assets Purchase Programme is captured by further loosening of the MCI.

As for EURIBOR, this indicator follows the policy rates (predominantly the main refinancing operations rate) in the whole period with a deviation during the financial crisis. Its development can be described by the same phasing as used in Chapter 3.3.3.

Although it does not include non-standard monetary policy measures as MCI does, it is still a standard in the financial industry, as it helps to ensure a homogeneous pricing benchmark for the entire money market yield curve across the euro area (ECB, 2013). To extend the data availability, I used an OECD (2020) database on national interbank rates which were active prior to the introduction of EURIBOR and added them to the indicator.

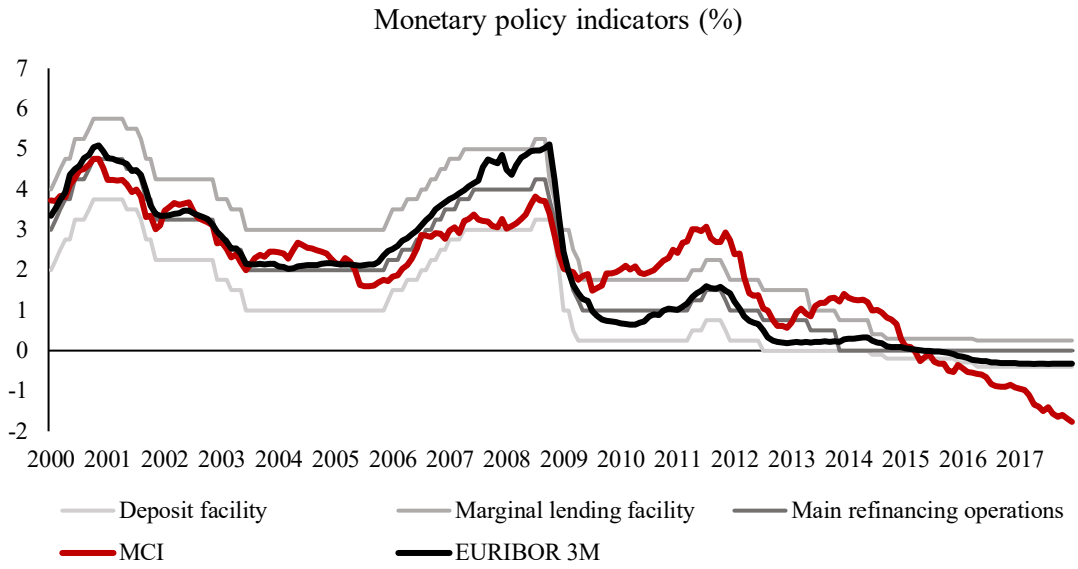


Figure 3.6: ECB rates vs. EURIBOR 3M vs. MCI

Source: ECB, 2020c; Hodula, 2019 (own elaboration)

3.6 Summary of the chapter

This chapter focuses on the analysed panel of European countries and explains how their institutional frameworks are set up in macroprudential and monetary policy.

Macroprudential policy framework derives from international standards set by BCBS with some additional features which reflect the situation in the EU. At the EU level, the European Systemic Risk Board is responsible for monitoring and assessment of systemic risk and it also serves as a source of a macroprudential measures database which will be used in the empirical part of this thesis. At the national level, institutional arrangements vary country by country, as some countries employ separated approach on macroprudential and designated authority while other have an arrangement where these two bodies are integrated in one institution.

Since the panel of analysed countries comprises only euro area countries, the monetary policy is under responsibility of the European Central Bank/Eurosystem. With the help of ECB's key interest rates, I explained key phases in the conduct of

monetary policy in the euro area. In the country-by-country analysis, I focus on if and how the institutional setup of macroprudential policy and monetary policy are linked and how many responsibilities are under the national central banks in this regard.

In the data part, I introduce and analyse the main variables for the empirical part. For economic growth, I will work with the most common measures (GDP and GVA). For financial development, the most suitable data are indices from Svirydzenka (2016). For capturing macroprudential policy, I employ two indices, as one focuses on frequency of use of instruments and the other on effects of such measures. As the monetary policy stances, I use an index capturing both conventional and unconventional monetary measures and EURIBOR appended by national 3-month interbank rates.

4 Analysis of interactions between the phenomena in the panel of countries

This chapter aims at examining the influence of financial development and macroprudential policy and its interaction on economic growth in the selected panel of countries.

4.1 Methodology of the empirical analysis

4.1.1 Theoretical background

Panel data is a data set constructed from repeated cross sections over time (Woolridge, 2013). According to Hsiao (2006), panel data have several advantages over cross-sectional or time-series data:

- more accurate inference of model parameters: Panel data usually contain more degrees of freedom and more sample variability than cross-sectional data, hence the efficiency of econometric estimate is improved.
- greater capacity for capturing the complexity of human behaviour: Panel data enable construction of more complicated behavioural hypotheses, control of the impact of the omitted variables, uncovering dynamic relationships, generation of more accurate predictions and providing micro foundations for aggregate data analysis.
- simplifying computation and statistical inference: The availability of panel data simplifies computation and inference in analysis of nonstationary time series, enables different transformations to eliminate measurement errors and allows researchers to simplify the analysed problem by only focusing on the subsample.

As mentioned in Baltagi (2008), limitations of panel data include:

- design and data collection problems: In panel data analysis, there may be problems of incomplete coverage, reference period, the use of bounding and time-in-sample bias.
- distortions of measurement errors: Measurement errors may arise because of faulty responses due to unclear questions, memory errors, deliberate distortion of responses (e.g. prestige bias), inappropriate informants, mis-recording of responses and interviewer effects.
- selectivity problems: These include self-selectivity (censorship within the sample), nonresponse (one or more questions are left unanswered) and attrition (issues with representativeness of the sample.

- short time-series dimension: Typical micro panels cover a short time span, so asymptotic arguments rely crucially on the number of individuals tending to infinity.
- cross-section dependence: Macro panels on countries or regions with long time series that do not account for cross-country dependence may lead to misleading inference. Therefore, panel unit root tests are suggested to examine this phenomenon.

In panel data regression, there are static and dynamic models. Static model is a model where only contemporaneous variables affect the dependent variable (Woolridge, 2013). Fixed effects model allows the unobserved effects to be arbitrarily correlated with the explanatory variable in each time period, while random effects model assumes that the unobserved effect is uncorrelated with the explanatory variables in each time period (Baltagi, 2008). Dynamic model includes lags of the dependent variable to provide an adequate characterization of many economic dynamic adjustments (Bun and Sarafidis, 2013). Arellano and Bond (1991) proposed a generalised method of moments (GMM) procedure[21], while Ahn and Schmidt (1995) derived additional nonlinear moment restrictions not exploited by the GMM estimator. This literature is generalized and extended by Arellano and Bover (1995)[22] and Blundell and Bond (1998)[23].

Furthermore, panel data models contain control variables which act as instrument variables (IV). Instrument variables must be correlated with the included endogenous variable(s), and orthogonal to the error process (Baum et al., 2003). In the model, instrument variables act as a natural safeguard against reverse causality, which allows the results to be interpreted as causal relationships rather than mere correlations. An interaction term is used to include interaction between two explanatory variables. Interaction term can be defined as an independent variable that is the product of two explanatory variables (Woolridge, 2013). In the model, I use it to see the implications of financial development when macroprudential policy is active.

The validity of GMM can be proven by diagnostic tests. The Arellano-Bond test tests for autocorrelation of the residuals. By construction, the residuals of the differenced equation should possess serial correlation, but if the assumption of serial independence

[21] The GMM estimator is a way of exploiting information from the general form of population moment conditions.
[22] Arellano and Bover (1995) present a GMM formulation with unrestricted covariance matrix, together with a derivation of the information bound for these models.
[23] Blundell and Bond (1998) consider two estimators which can improve the precision of the standard first-differenced GMM estimator.

in the original errors is warranted, the differenced residuals should not exhibit significant AR (2) behaviour. If a significant AR (2) statistic is encountered, the second lags of endogenous variables will not be appropriate instruments for their current values. The Hansen test focuses on overidentifying restriction. The Hansen statistic will be identically zero for any exactly identified equation and will be positive for an overidentified equation.

4.1.2 Methods and processes in the empirical analysis

In this chapter, I describe concrete steps in the process in my empirical research. Based on literature review, the working hypothesis is that financial development has positive effect on economic growth in the analysed panel of countries. In other words, I assume that faster financial development implicates faster economic growth. Before the econometric modelling, I construct a basic specification of the model (based on economic theory and literature review) and prepare all raw data. After that, I conduct a time series analysis on the raw data to examine their stationarity and where applicable and appropriate, I transform the data to make them stationary.

When the data is ready, I use dynamic panel regression (GMM estimator with Driscoll and Kraay (1998) standard errors) for the basic specification. I have chosen the dynamic model to cover omitted variable bias and to account for transmission lags in the model. In the regression, I work with different indicators for economic growth (as mentioned in Chapter 3.5.3) and monetary policy (as mentioned in Chapter 3.5.4). Together with the coefficients for each variables, I table the p-values for two diagnostic tests: the test of the null hypothesis that the errors in the first difference regression exhibit no second-order serial correlation (AR (2) test) and p-values for the test of the null hypothesis that the instruments used are valid (Hansen). After that, I employ static panel data regression with fixed effects and compare its estimates with the GMM results to check for robustness.

As I also examine the influence of both financial development and macroprudential policy on economic growth, I extend the baseline specification by adding an interaction term which enables me to study the impact of financial development on economic growth when the macroprudential policy is active. After analysis of interactions between financial development as a whole and macroprudential policy, I employ the sub-indices of financial development (see Chapter 3.5.1) to explore channels through which macroprudential policy affects the finance-growth relationship.

4.2 Panel regression

4.2.1 Specification of the model

In the empirical analysis, I use dynamic model of panel regression where the dependent variable is lagged, and the control variables serve as instrumental variables to limit reverse causality. The baseline specification is as follows:

$$y_{it} = \alpha_i + y_{it-1} + \beta FDI_{it-1} + \gamma Controls_{it} + \varepsilon_{it} \quad (4.1)$$

where i and t are indices for countries and years respectively, α stands for country-fixed effects, y is a measure of economic growth and FDI is a measure of financial development. The beta coefficient (β) measures the strength of the finance-growth relationships. The vector of control variables includes: (i) trade openness (export to GDP), (ii) labour productivity growth, (iii) inflation rate, (iv) monetary policy stance (interbank rate/EURIBOR or MCI) and (v) financial crisis dummy[24]. To remove country fixed effects, the model is specified in first differences (Δ):

$$\Delta y_{it} = \alpha_i + y_{it-1} + \beta \Delta FDI_{it-1} + \gamma \Delta Controls_{it} + \Delta\varepsilon_{it} \quad (4.2)$$

In the differenced model, $\Delta\varepsilon_{it}$ is a function of ε_{it-i}, so the correlation between the lagged dependent variable and the differenced error is remaining. Nickell (1981) state that this correlation causes the commonly employed standard fixed effects estimator to produce biased estimates. Therefore, I use the system-GMM estimator by Arellano and Bond (1991), as it addresses the endogeneity problems resulting from the correlation.

To control the effect of macroprudential policy on financial development, I augment equation (4.2) with an interaction term which is the product of financial development index and macroprudential policy indicator[25] (MPP). The extended specification is as following:

$$\Delta y_{it-1} = \alpha_i + y_{it-1} + \beta \Delta FDI_{it-1} + \gamma \Delta MPP_{it-1} + \zeta FDI_{it-1} \times MPP_{it-1} + \eta \Delta Controls_{it} + \Delta\varepsilon_{it} \quad (4.3)$$

In the extended specification (equation 4.3), I extend my range of models by using interaction terms. I employ three interaction terms for aggregated financial development ($FDI \times MPI$ and $FDI \times PPI$ respectively), development of financial institutions

[24] The financial crisis dummy takes the value of 1 if there was a crisis and 0 otherwise.
[25] As macroprudential policy indicators, I use Macroprudential Policy Index (MPI) and Prudential Policy Index (PPI). See Chapter 3.5.3 for further description.

($FDI\_FI \times MPI$ and $FDI\_FI \times PPI$ respectively) and development of financial markets ($FDI\_FM \times MPI$ and $FDI\_FM \times PPI$ respectively) with macroprudential policy.

The choice of control variables deserves further elaboration. My reasoning is as follows:

- **Trade openness** – Emery (1968) proves a positive correlation between export and economic growth and Balassa (1978) indicates that export growth favourably affects the rate of economic growth. Chang et al. (2009) state that trade openness is associated with faster economic growth and can be further enhanced by implementation of complementary reforms aiming at removing trade barriers. I work with a similar hypothesis where more open economies benefit from faster economic growth.
- **Labour productivity** – ILO (2013) finds that that increases in labour productivity within economic sectors are the main drivers of economic growth and in particular, growth in industry and services plays an important role for aggregate economic growth. I work with a hypothesis that faster labour productivity growth implicates faster economic growth.
- **Inflation rate** – The findings of Barro (1996) show that economic growth is enhanced by lower inflation. Sarel (1995) finds that when the inflation rate is above 8 percent, the estimated effect of inflation on economic growth is significant, robust and powerful. López-Villavicencio and Mignon (2011) state that there is a threshold under which inflation exerts a positive effect on growth. Using the optics of macroeconomic models, I expect the inflation-growth relationship to be positive.
- **ECB monetary policy stance** – Monetary policy affects inflation, the unemployment rate or the rate of growth of an economy by altering aggregate supply and demand. It is of a countercyclical nature, but the transmission of monetary policy to the real economy is lagged (Havránek and Rusnák, 2013). To account for this, the monetary policy indicators enter the model lagged by one year. My hypothesis is that monetary policy is countercyclical, so its effects on the economic growth is expected to be negative.
- **Financial crisis dummy** – The binary dummy variable captures systemic crises which may take form of global financial crisis or national crises. Jarrow (2014) shows that financial crises negatively affects economic growth and capital. My hypothesis is that financial crises have a strong and negative impact on economic growth.

4.2.2 Summary and analysis of input data

For both baseline and extended specification, I use 13 different variables: three measures of financial development, three measures of economic growth, two indicators for macroprudential policy and two monetary policy stances (**Table 4.1**). I work with data on an annual frequency from 1980 to 2017. The models where GDP growth and GDP per capita growth are employed are unbalanced, while the models with GVA growth are balanced due to limitations in this dataset which are common for all countries in the panel.

The measures of financial development were available as a 0-1 index. To improve their usability and better observation of captured differences, I multiplied the initial values by 100. After that, I transformed the data to first differences, as the initial data were not stationary. The measures of economic growth (GDP, GDP per capita and GVA) are ready-to-use data in annual growth rates. The Macroprudential Policy Index is ready to use without any transformations. Regarding the Prudential Policy Index, the data are on a quarterly basis, so I used an average value of the quarters for each year. Both indices were not transformed because of their binary nature.

Among the control variables, trade openness and inflation were available as ready-to-use data for all countries for the whole period. The data on labour productivity were also available from 1980, but there are some gaps (for Austria, the data are available from 1996 and for Greece, the availability starts in 1984). Regarding data on monetary policy, the Monetary Conditions Index is available from 2000. In the case of EURIBOR, I extended the dataset by adding national 3-month interbank rates for the 1980-1993 period. In these, there are some missing data (in the case of Austria, Finland, Greece, Ireland, Luxembourg and Portugal). The financial crisis binary dummy is created on the basis of list of systemic crises by ESRB (2017).

Variable	Mnemonics	Start date	End date	Mean	Std. Dev.	Min	Max	Units	Source	Gaps	Description
GDP growth	GDP_GR	1980	2017	2.21	2.64	-9.13	10.90	%	The World Bank (2020b)	no	The market value of final goods and services produced in the economy during a year.
GDP per capita growth	GDPPC_GR	1980	2017	1.71	2.57	-9.00	9.80	%	The World Bank (2020c)	no	The value of all goods and services produced by a country divided by the country's population.
GVA growth	GVA_GR	1996	2017	1.97	2.79	-9.69	10.22	%	WIIW (2020)	no	Output (at basic prices) minus intermediate consumption (at purchaser prices).
Financial development index	FDI	1980	2017	59.52	15.95	25.07	91.16	index	Svirzdyenka (2016)	no	Index capturing depth. access and efficiency of both financial institutions and markets.
FDI (institutions)	FDI_FI	1980	2017	72.44	11.89	44.29	96.11	index	Svirzdyenka (2016)	no	Index capturing depth, access and efficiency of financial institutions.
FDI (markets)	FDI_FM	1980	2017	45.33	23.31	3.77	90.83	index	Svirzdyenka (2016)	no	Index capturing depth, access and efficiency of financial markets.
Macroprudential Policy Index	MPI	2000	2017	1.75	1.33	0.00	5.00	index	Cerutti et al. (2015)	no	Index capturing cumulative use of macroprudential policy measures (without their effect).
Prudential Policy Index	PPI	2000	2017	0.16	1.78	-2.00	7.00	index	Cerutti et al. (2017)	no	Index capturing changes in prudential policy tools (tightening or loosening).
Labour productivity growth	LABOUR	1980	2017	1.71	2.57	-5.81	19.87	%	OECD (2020a)	yes	Labour productivity reflects growth in GDP per hour worked.
Trade openness	EXPORT	1980	2017	47.79	36.20	14.05	221.20	%	The World Bank (2020a)	no	Value of all goods and other market services provided to the rest of the world.
Inflation	INFLATION	1980	2017	4.07	4.79	-4.48	28.38	%	The World Bank (2020d)	no	The annual percentage change in the cost to the average consumer of acquiring a basket of goods and services.
Monetary Conditions Index	MCI	2000	2017	1.93	1.51	-1.41	4.26	%	Hodula (2019)	no	Index capturing the effect of conventional and unconventional monetary policies.
Interbank rates/EURIBOR	EURIBOR	1980	2017	5.00	4.59	-0.33	20.05	%	ECB (2020c); OECD (2020b)	yes	The national interbank rates (data from 1980 to 1993) and the Euro Interbank Offered Rate (EURIBOR) from 1994 onwards.

Table 4.1: Data overview and summary statistics

Source: own elaboration in STATA

Note: The columns "Start date" and "End date" capture beginning and ending of the sample period for all countries. To account for missing data, the column "Gaps" indicates whether there are any missing data for the countries in the sample.

4.3 Estimation results

4.3.1 Implications of financial development for economic growth

In the baseline specification (equation 4.2), I focus on the finance-growth relationship separately, without the influence of macroprudential policy. Each of the economic growth measures enter separately into the model and for capturing financial development, I use the aggregated index. The models where the MCI is used (columns 1a-1c) are based on balanced datasets, while the models with interbank rate/EURIBOR are unbalanced when GDP growth and GDP per capita growth (columns 2a-2b) is employed and balanced when GVA growth is used.

The results for the baseline specification (**Table 4.2**) already indicate some interesting patterns. The response of economic growth to financial development is positive and statistically significant. The beta coefficients (third line) confirm the view where the finance-growth relationship is positive, i.e. faster financial development implicates faster economic growth. Faster improvements in depth, access and efficiency of financial institutions and financial markets contribute to faster economic growth. Faster financial development implicates that financial instruments, markets and intermediaries mitigate the effects of imperfect information, limited enforcement of contracts and transaction costs better, thus contributing to the improvements in functions of the financial sector which ensures sustainable growth. Faster establishment and expansion of institutions, instruments and markets within the financial system support investment and economic growth process. Financial development promotes economic growth through accumulation of capital and technological progress, reduces in poverty and inequality by broadening access to finance to the poor and vulnerable and by increases in investment and productivity. To rephrase it, the more developed and better-functioning financial systems, the faster economic growth can be observed.

My results are in line with those of King and Levine (1993) who conclude that indicators of the level of financial development are strongly and robustly correlated with economic growth. Furthermore, the results are in accordance with conclusions of three meta-analyses on the finance-growth relationship. Arestis et al. (2014) analyse 1151 estimates from 69 papers and find that there is a positive and significant effect of more finance on growth. Valickova et al. (2015) show that 1334 estimates from 67 analysed studies document a moderate, but statistically significant positive link between financial development and economic growth. Based on a meta-analysis of

68 empirical studies, Biljsma et al. (2018) point to a positive, but decreasing effect of financial development on economic growth, showing that pre-crisis estimates (e. g. from the above-mentioned seminal study of King and Levine) were overly optimistic. However, the meta-analyses work with studies that use proxies capturing particular aspects of financial development (financial depth, bank ratio, financial activity, stock markets) or their alternatives[26], but no aggregate measures (which is present in my model). Therefore, the employment of the aggregated financial development index which captures multiple aspects of the phenomena as a single variable to the model analysing the finance-growth nexus is my contribution to the contemporary research of this relationship.

The coefficients of labour productivity (fourth line) indicate that there is a positive and statistically significant relationship between labour productivity and economic growth. The growth in labour productivity (caused for instance by improvements in human capital and technological change) positively impacts economic growth, i.e. faster labour productivity growth implicates faster economic growth. My findings prove that labour productivity is a key contributor to economic performance (ILO, 2013).

The coefficients of trade openness (fifth line) show that the relationship between export and growth is positive and statistically significant. The more open an economy is, the faster growth it observes. This is in line with both the neoclassical approach and the endogenous growth theory. Free flow of goods and services is one of the key freedoms in the European Union and the benefits of Single Market and common trade policy with third countries are enhancing the effects of trade openness on economic growth. The results are in line with findings of Chang et al. (2009) who state that trade openness is associated with faster economic growth and can be further enhanced by implementation of complementary reforms aiming at removing trade barriers.

There is a positive and statistically significant relationship between inflation and economic growth (sixth line). In the models where the MCI is employed (columns 1a-1c), this can be explained by the fact that the analysed time frame is shorter (2000-2017) and in this period, the average inflation rate was below the target value of 2 %, thus these

[26] The proxies used in studies analysed in the meta-analysis were: liquid liabilities to GDP, bank credit to the sum of bank credit and domestic assets of the central bank, domestic credit to GDP, credit allocated to private enterprises to GDP, stock market capitalisation ratio, stock market activity, stock market turnover ratio, overall stock market development, share of resources devoted to the financial system and deposit money bank assets to GDP.

results are in line with findings of Barro (1996) which indicate that economic growth is enhanced by lower inflation. In the models with interbank rates and EURIBOR (columns 2a-2c) which work on a longer time span, the results are in accordance with findings of López-Villavicencio and Mignon (2011), who state that there exists a threshold under which inflation exerts a positive effect on growth.

The coefficients on the MCI and interbank rates/EURIBOR are negative and statistically significant, implicating that growth in monetary policy measures negatively affects economic growth. When the key interest rates are lowered, the costs of borrowing are lower, resulting in higher investment and consumption and vice versa. From comparison between the two indicators, it can be concluded that the existence of monetary union improves the countercyclical effects of monetary policy (columns 1a-1c), whilst inclusion of the pre-monetary union period (columns 2a-2c) weakens these effects. My findings are in line with Vickers (2000) who state that monetary policy aimed at securing and maintaining price stability is supportive to economic growth and that the deepening of the Single Market caused by monetary policy is also positive for growth.

In line with the economic theory, the financial crisis dummy has negative and statistically significant relationship with economic growth. This indicates that economic growth was significantly slowed down during the periods of systemic crises included in the dummy. The costs of financial crises take the biggest toll on economic growth among all control variables.

The p-values of Arellano-Bond test for autocorrelation of the residuals (AR (2)) are all (except column 2c) statistically significant, so null hypothesis (the errors in the first difference regression exhibit no second-order serial correlation) is rejected. On the opposite hand, results of AR (2) for column 2c indicate that the null hypothesis is retained. Regarding the p-values of Hansen test on overidentifying restriction, they are in all cases close to zero and therefore, the null hypothesis (the instruments used are valid) is rejected.

Dependent variable	*(1a)* GDP growth	*(1b)* GDP per capita growth	*(1c)* GVA growth	*(2a)* GDP growth	*(2b)* GDP per capita growth	*(2c)* GVA growth
Lagged dependent variable	**-0.287****	**-0.221***	**-0.275*****	**-0.176***	**-0.186****	**-0.209****
	(0.128)	**(0.123)**	**(0.090)**	**(0.099)**	**(0.088)**	**(0.105)**
Financial development index	**0.134*****	**0.132*****	**0.153*****	**0.132*****	**0.129*****	**0.135*****
	(0.021)	**(0.022)**	**(0.021)**	**(0.014)**	**(0.014)**	**(0.023)**
Labour productivity growth	**0.520*****	**0.542*****	**0.468****	**0.605*****	**0.623*****	**0.540*****
	(0.177)	**(0.186)**	**(0.197)**	**(0.144)**	**(0.143)**	**(0.205)**
Trade openness	**0.019*****	**0.005****	**0.018*****	**0.019*****	**0.007****	**0.020*****
	(0.004)	**(0.002)**	**(0.005)**	**(0.004)**	**(0.003)**	**(0.005)**
Inflation	**0.684*****	**0.541*****	**0.825*****	**0.291*****	**0.250*****	**0.606****
	(0.208)	**(0.189)**	**(0.258)**	**(0.094)**	**(0.083)**	**(0.237)**
Monetary Conditions Index	**-0.496*****	**-0.575*****	**-0.518*****			
	(0.059)	**(0.073)**	**(0.110)**			
Interbank rates/EURIBOR				**-0.135*****	**-0.125*****	-0.042
				(0.039)	**(0.042)**	(0.057)
Financial crisis dummy	**-2.430*****	**-2.004*****	**-2.089*****	**-2.476*****	**-2.234*****	**-2.476*****
	(0.686)	**(0.596)**	**(0.458)**	**(0.691)**	**(0.619)**	**(0.561)**
Constant	**0.719****	**0.974****	0.458	**1.034*****	**0.955*****	0.030
	(0.359)	**(0.430)**	(0.341)	**(0.372)**	**(0.317)**	(0.343)
Observations	204	204	204	381	381	252
AR (2)	0.042	0.024	0.016	0.041	0.030	0.053
Hansen	0.024	0.026	0.022	0.009	0.009	0.029

Table 4.2: Results for the baseline specification

Source: own elaboration in STATA

*Note: Driscoll and Kraay (1998) robust standard errors are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively. Different number of observations is caused by availability of data (as explained in Chapter 4.2.2).*

4.3.2 Interaction between aggregated financial development and macroprudential policy

In this chapter, I employ the extended model (equation 4.3). In addition to the baseline specification, I use two indicators capturing macroprudential policy – the MPI which contains the frequency of used instruments regardless of their nature, and the PPI which includes effects of the policy decisions as well. Each measure of economic growth enters in separate models, combined with either the MCI (columns 1a-1c and 2a-2c) or interbank rate/EURIBOR (columns 1d-1f and 2d-2f) as the monetary policy stance and I use the aggregated financial development index. All models included in this chapter work with balanced data for 2000-2017 period.

The results (**Table 4.3**) show that the inclusion of macroprudential policy (without considering its activity) in the model weakens the positive effects of financial development on economic growth. However, faster financial development still has positive impact on economic growth and the coefficients are all statistically significant. As mentioned before, financial development implicates improvements in the functions of

the financial sector which positively contributes to economic growth. When financial development is limited, the impact on economic growth is correspondingly lower, because its contribution to the economy is outweighed by other variables.

The coefficients of the two macroprudential policy indicators differ based on which one is employed. In the case of the MPI, the values are negative and not statistically significant (except column 1b) which is related to the fact that it captures only frequency of changes in macroprudential policy nature, regardless of their nature (tightening or loosening). In general, more frequent use of macroprudential policy measures seems to moderately reduce the economic growth. Macroprudential policy aims at limiting excessive booms in asset prices and credit, as excess growth in these variables causes financial instability and lower economic growth (which may end up as a crisis situation). Since macroprudential policy is of a preventive nature, it may be overly limiting in terms of its influence on consumption and investment, thus causing lower economic growth. The results are in line with Sánchez and Rohn (2016) who also employ the MPI to investigate the link between macroprudential policy and GDP growth and conclude that the use of macroprudential policies may be associated with lower economic growth. For the PPI, the coefficients are positive (except column 2b and 2e), but also not statistically significant. Macroprudential policy generate benefits for the economy by reducing systemic risk and lowering the probabilities of crises and improving financial stability. Since financial stability is a prerequisite for sustainable growth, the growing role of macroprudential policy is expected to contribute to faster economic growth. These findings are in line with Boar et al. (2017) whose findings conclude that more active macroprudential policies are associated with higher growth rates (in their study, they used real GDP per capita growth). The sensitivity of research outcomes on macroprudential policy to specific modelling assumptions which is present in my estimations is documented in the meta-analysis of Fidrmuc and Lind (2018)[27] who state that the estimates are mainly driven by modelling choices and the general focus of a study. Since macroprudential policy includes relatively new tools, more evidence and experience are needed to offer a conclusive response regarding the impacts of macroprudential policy on real economy.

[27] This meta-analysis finds a relatively moderate negative effect on the real economy in response to a change in minimum capital requirements. I did not include these findings in my description, as the sample of analysed studies works mostly with pre-crisis periods (before the introduction of new instruments in BASEL III) and the examined macroprudential policy variable was a single measure.

The coefficients of the interaction term ($FDI \times MPI$ and $FDI \times PPI$ respectively) show that active macroprudential policy has a positive impact on the contribution of financial development for economic growth. In other words, macroprudential policy enhances financial development in a way where their interaction promotes economic growth, as it limits the risk of widespread disruptions to the provision of financial services based on financial development and eliminates possible impacts of such disruptions on the economy. First, I used an indicator which captures changes in frequency of use of macroprudential measures and an increase in it indicates increased frequency of use, without considering the effect of a policy measure. The coefficients of the $FDI \times MPI$ interaction (columns 1a-1f) are positive, but not statistically significant. Based on that, the more frequent use of macroprudential policy measures restrict the effect of financial development on economic growth, but the interaction between the two phenomena has a positive relationship with economic growth. Second, I used an indicator containing the frequency of tightening policy measures where an increase in corresponds to growth in restrictive macroprudential policy measures. The coefficients of the $FDI \times PPI$ regression (columns 2a-2f) indicate that more active use of restrictive macroprudential policy measures limits risks in the financial sector, it also limits the costs of possible financial crises (i.e. macroprudential policies are designed to make financial crisis less severe). To sum it up, macroprudential policy aims at reducing the risks from excessive growth caused by financial development and deepening while maintaining sustainable economic growth. Therefore, it should be actively implemented to restrict the possible disruptions. Over other public policies, macroprudential measures benefits from smaller implementation lags, the possibility to tailor the policy instruments to specific risks without causing a generalised reduction in economic growth and limiting the costs of policy intervention.

Dependent variable	*(1a)* GDP growth	*(1b)* GDP per capita growth	*(1c)* GVA growth	*(1d)* GDP growth	*(1e)* GDP per capita growth	*(1f)* GVA growth	*(2a)* GDP growth	*(2b)* GDP per capita growth	*(2c)* GVA growth	*(2d)* GDP growth	*(2e)* GDP per capita growth	*(2f)* GVA growth
Lagged dependent variable	**-0.275****	**-0.205***	**-0.262*****	**-0.234***	-0.178	**-0.216****	**-0.223***	-0.192	**-0.252*****	**-0.210***	-0.152	**-0.188***
	(0.126)	**(0.124)**	**(0.086)**	**(0.127)**	(0.119)	**(0.093)**	**(0.119)**	(0.122)	**(0.094)**	**(0.127)**	(0.117)	**(0.101)**
Financial development index	**0.086****	**0.077***	**0.126*****	**0.097****	**0.092****	**0.134****	**0.246*****	**0.142*****	**0.166*****	**0.148*****	**0.143*****	**0.164*****
	(0.039)	**(0.039)**	**(0.047)**	**(0.046)**	**(0.043)**	**(0.060)**	**(0.092)**	**(0.020)**	**(0.017)**	**(0.019)**	**(0.019)**	**(0.021)**
Macroprudential Policy Index	-0.186	**-0.302****	-0.209	-0.023	-0.147	-0.057						
	(0.192)	**(0.144)**	(0.200)	(0.162)	(0.122)	(0.175)						
Prudential Policy Index							0.129	-0.068	0.051	0.019	-0.012	0.101
							(0.134)	(0.057)	(0.106)	(0.066)	(0.051)	(0.098)
$FDI \times MPI$	0.036	0.040	0.019	0.028	0.031	0.012						
	(0.024)	(0.026)	(0.028)	(0.026)	(0.025)	(0.034)						
$FDI \times PPI$							**0.412*****	**0.048****	**0.053*****	**0.057****	**0.045***	**0.052****
							(0.138)	**(0.022)**	**(0.020)**	**(0.026)**	**(0.025)**	**(0.024)**
Labour productivity	**0.508*****	**0.523*****	**0.454****	**0.514*****	**0.519*****	**0.462****	**0.612*****	**0.556*****	**0.485****	**0.541*****	**0.552*****	**0.496****
	(0.179)	**(0.186)**	**(0.199)**	**(0.192)**	**(0.198)**	**(0.213)**	**(0.154)**	**(0.179)**	**(0.194)**	**(0.185)**	**(0.194)**	**(0.209)**
Trade openness	**0.017*****	0.002	**0.016*****	**0.018*****	0.004	**0.017*****	**0.018*****	**0.005***	**0.018*****	**0.018*****	**0.005****	**0.017*****
	(0.004)	(0.003)	**(0.004)**	**(0.004)**	(0.003)	**(0.004)**	**(0.004)**	**(0.003)**	**(0.004)**	**(0.004)**	**(0.002)**	**(0.004)**
Inflation	**0.690*****	**0.548*****	**0.828*****	**0.599*****	**0.460****	**0.743*****	**0.738*****	**0.519*****	**0.820*****	**0.577*****	**0.436****	**0.735*****
	(0.197)	**(0.177)**	**(0.245)**	**(0.201)**	**(0.183)**	**(0.246)**	**(0.207)**	**(0.189)**	**(0.269)**	**(0.218)**	**(0.193)**	**(0.274)**
Monetary Conditions Index	**-0.626*****	**-0.766*****	**-0.653*****				**-0.491*****	**-0.638*****	**-0.523*****			
	(0.129)	**(0.113)**	**(0.179)**				**(0.095)**	**(0.085)**	**(0.096)**			
Interbank rates/EURIBOR				**-0.280*****	**-0.419*****	**-0.319****				**-0.265*****	**-0.370*****	**-0.270*****
				(0.098)	**(0.091)**	**(0.138)**				**(0.074)**	**(0.084)**	**(0.094)**
Financial crisis dummy	**-2.447*****	**-2.040*****	**-2.115*****	**-2.452*****	**-2.084*****	**-2.133*****	**-2.508*****	**-1.988*****	**-2.065*****	**-2.407*****	**-2.002*****	**-2.050*****
	(0.687)	**(0.601)**	**(0.462)**	**(0.694)**	**(0.614)**	**(0.483)**	**(0.639)**	**(0.577)**	**(0.448)**	**(0.681)**	**(0.594)**	**(0.467)**
Constant	**1.412***	**2.061*****	1.219	0.391	**1.074***	0.236	**0.691***	**1.156*****	0.471	0.326	0.653	-0.024
	(0.733)	**(0.704)**	(0.760)	(0.612)	**(0.629)**	(0.647)	**(0.419)**	**(0.424)**	(0.367)	(0.364)	(0.433)	(0.366)
Observations	204	204	204	216	216	216	204	204	204	216	216	216
AR (2)	0.043	0.026	0.016	0.074	0.044	0.023	0.049	0.029	0.019	0.090	0.049	0.026
Hansen	0.018	0.020	0.017	0.019	0.021	0.019	0.010	0.023	0.023	0.025	0.024	0.031

Table 4.3: Results for the extended specification with $FDI \times MPP$ interaction term

Source: own elaboration in STATA

*Note: Driscoll and Kraay (1998) robust standard errors are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.*

4.3.3 Interaction between development of financial institutions and macroprudential policy

In this chapter, I employ the extended model specification (equation 4.3) to focus on interaction between development of financial institutions and macroprudential policy and its implications for economic growth. The sub-index of financial institutions development measures how developed they are in terms of depth, access and efficiency. The depth of financial institutions development is proxied by private-credit to GDP and assets of other financial institutions to GDP, the access to financial institutions is proxied by the number of bank branches and ATMs per 100 000 adults and he efficiency aspect relies on efficiency in intermediating savings to investment, operational efficiency measures and profitability measures (Svirydzenka, 2016). All models work with balanced data for 2000-2017 period.

The results (**Table 4.4**) show that the coefficients of financial institutions development sub-index (third line) are positive, but not statistically significant (except columns 2d and 2f). To rephrase it, the developments in the depth, access and efficiency of financial institutions do not have an impact economic growth. The coefficients of macroprudential policy (fourth and fifth line) are all negative, but only three of them are statistically significant (columns 1b, 2a and 2b). The coefficients of the MPI (columns 1a-1f) indicate that growing frequency of use of macroprudential policy instruments limits economic growth. While macroprudential policy aims at ensuring sustainable growth by targeting financial stability, the growing use of its instruments slows down economic growth, because the credit-based measures limit the developments in this sector to prevent possible crises and their impacts. In the case of the PPI (columns 2a-2f), the coefficients implicate that the more restrictive macroprudential policy, the slower economic growth. Implementation of restrictive macroprudential policy measures limits the growth by restricting the levels of credit which curb investment and consumption in the economy.

For the interaction term ($FDI\_FI \times MPI$ and $FDI\_FI \times PPI$ respectively), all coefficients are negative and not statistically significant. This implicates that when the macroprudential policy measures limit the development of financial institutions, it may dampen the positive impact on economic growth. To sum it up, development of financial institutions in terms of depth, access, and efficiency coupled with restrictive MPP do not have any implications for economic growth.

Dependent variable	*(1a)* **GDP growth**	*(1b)* **GDP per capita growth**	*(1c)* **GVA growth**	*(1d)* **GDP growth**	*(1e)* **GDP per capita growth**	*(1f)* **GVA growth**	*(2a)* **GDP growth**	*(2b)* **GDP per capita growth**	*(2c)* **GVA growth**	*(2d)* **GDP growth**	*(2e)* **GDP per capita growth**	*(2f)* **GVA growth**
Lagged dependent variable	**-0.230***	-0.161	**-0.222****	-0.173	-0.122	-0.160	-0.212	-0.144	**-0.215***	-0.145	-0.091	-0.135
	(0.135)	(0.133)	**(0.105)**	(0.135)	(0.129)	(0.112)	(0.138)	(0.130)	**(0.119)**	(0.140)	(0.129)	(0.127)
FDI (institutions)	0.090	0.056	0.086	0.127	0.093	0.132	0.065	0.057	0.066	**0.077***	0.069	**0.087***
	(0.084)	(0.060)	(0.068)	(0.101)	(0.078)	(0.091)	(0.046)	(0.047)	(0.053)	**(0.046)**	(0.046)	**(0.051)**
Macroprudential Policy Index	-0.201	**-0.310****	-0.223	-0.059	-0.172	-0.091						
	(0.192)	**(0.141)**	(0.202)	(0.157)	(0.119)	(0.168)						
Prudential Policy Index							**-0.115****	**-0.136****	-0.023	-0.067	-0.093	0.014
							(0.051)	**(0.055)**	(0.069)	(0.059)	(0.061)	(0.066)
FDI_FI × MPI	-0.010	0.011	-0.009	-0.027	-0.006	-0.026						
	(0.056)	(0.045)	(0.049)	(0.064)	(0.052)	(0.060)						
FDI_FI × PPI							-0.058	-0.065	-0.082	-0.079	-0.081	-0.094
							(0.055)	(0.055)	(0.068)	(0.059)	(0.059)	(0.070)
Labour productivity	**0.492*****	**0.509*****	**0.441****	**0.494****	**0.502****	**0.445****	**0.527*****	**0.552*****	**0.481****	**0.533*****	**0.550*****	**0.493****
	(0.185)	**(0.192)**	**(0.203)**	**(0.197)**	**(0.203)**	**(0.215)**	**(0.173)**	**(0.178)**	**(0.188)**	**(0.185)**	**(0.190)**	**(0.200)**
Trade openness	**0.015*****	0.001	**0.015*****	**0.017*****	0.003	**0.016*****	**0.017*****	**0.004****	**0.016*****	**0.016*****	**0.004*****	**0.016*****
	(0.003)	(0.002)	**(0.004)**	**(0.003)**	(0.003)	**(0.004)**	**(0.003)**	**(0.002)**	**(0.004)**	**(0.003)**	**(0.001)**	**(0.003)**
Inflation	**0.659*****	**0.519*****	**0.813*****	**0.560*****	**0.426****	**0.718*****	**0.623*****	**0.480****	**0.790*****	**0.520****	**0.390***	**0.694****
	(0.210)	**(0.191)**	**(0.266)**	**(0.210)**	**(0.193)**	**(0.264)**	**(0.218)**	**(0.196)**	**(0.286)**	**(0.223)**	**(0.200)**	**(0.293)**
Monetary Conditions Index	**-0.604*****	**-0.744*****	**-0.637*****				**-0.538*****	**-0.620*****	**-0.497*****			
	(0.125)	**(0.111)**	**(0.177)**				**(0.075)**	**(0.087)**	**(0.093)**			
Interbank rates/EURIBOR				**-0.285*****	**-0.417*****	**-0.329*****				**-0.273*****	**-0.368*****	**-0.269*****
				(0.085)	**(0.085)**	**(0.118)**				**(0.068)**	**(0.076)**	**(0.076)**
Financial crisis dummy	**-2.550*****	**-2.148*****	**-2.267*****	**-2.525*****	**-2.173*****	**-2.244*****	**-2.443*****	**-2.021*****	**-2.143*****	**-2.390*****	**-2.006*****	**-2.081*****
	(0.741)	**(0.659)**	**(0.556)**	**(0.747)**	**(0.670)**	**(0.571)**	**(0.671)**	**(0.585)**	**(0.500)**	**(0.687)**	**(0.605)**	**(0.520)**
Constant	**1.503****	**2.137*****	**1.314***	0.588	**1.227***	0.426	**0.905****	**1.168*****	0.461	0.395	0.691	0.009
	(0.740)	**(0.714)**	**(0.773)**	(0.613)	**(0.644)**	(0.620)	**(0.370)**	**(0.438)**	(0.389)	(0.366)	(0.429)	(0.377)
Observations	204	204	204	216	216	216	204	204	204	216	216	216
AR (2)	0.020	0.016	0.009	0.050	0.040	0.016	0.021	0.014	0.010	0.052	0.032	0.020
Hansen	0.012	0.014	0.010	0.012	0.014	0.012	0.016	0.018	0.016	0.020	0.020	0.023

Table 4.4: Results for the extended specification with FDI_FI × MPP interaction term

Source: own elaboration in STATA

*Note: Driscoll and Kraay (1998) robust standard errors are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively*

4.3.4 Interaction between development of financial markets and macroprudential policy

In this chapter, I employ the extended model specification (equation 4.3) to focus on interaction between development of financial markets and macroprudential policy and its implications for economic growth. The financial markets development sub-index measures improvements in depth, access and efficiency of stock markets and debt markets. The depth aspect contains indicators on size and activity of the stock market and volume of debt securities (international and domestic), the access is proxied by the percentage of market capitalisation outside of top 10 largest companies and number of issuers on the domestic and external debt market per 100 000 adults and the efficiency sub-index relies on the stock market turnover ratio (value of stocks traded to stock market capitalisation) (Svirydzenka, 2016). All models work with balanced data for 2000-2017 period.

The results (**Table 4.5**) indicate that development of financial markets is positively associated with economic growth and that the coefficients are statistically significant in half of the cases (columns 2a-2c). The financial market indicator focuses on stock market and debt market development. The developments in stock markets have strong and significant positive relationship with economic growth, as effective stock and debt markets attract more investment by financing productive projects, mobilise domestic savings, allocate capital proficiency, reduce risk by its diversifying and facilitate better exchange of goods and services (Caporale et al., 2004; de Bondt, 2002). To sum it up, faster developments in depth, access and efficiency of financial markets are positive contributors to economic growth. Among the two analysed sub-indices, the developments in financial markets are more important for economic growth, as they lead the overall growth contributions. The coefficients of macroprudential policy are negative (except columns 2c and 2f), but also not statistically significant. In the case of MPI, the relationship between more frequent use of macroprudential policy instruments and economic growth indicate that macroprudential policy prevents the build-ups of excessive and unsustainable levels of private and public debt to ensure financial stability, resulting in limits in economic growth. For the PPI, the results implicate that the more restrictive policy measures are implemented, the more limited is the economic growth.

For the interaction term ($FDI\_FM \times MPI$ and $FDI\_FM \times PPI$ respectively), all coefficients have positive sign and are statistically significant (except column 1f). The

findings implicate that more frequent use of macroprudential policy measures (captured by the MPI) together with financial markets development contributes positively to economic growth. However, it is notable that the interaction partially offsets the overall impacts. When the development of financial markets enters the model separately, its growth by 1 implicates GDP growth by 3.6 p.p., but when the sub-index interacts with more frequent use of macroprudential policy, the GDP growth is only by 2.7 pp. (column 1a). In the case when the effect of macroprudential measures is considered, separate financial markets development implicates GDP growth by 8.7 p.p., while implementation of restrictive macroprudential policy instruments limits the GDP growth to 4.8 pp. (column 2a). Debt overhang is a crucial determinant of the likelihood of financial crises, as a resulting negative shock to the economy may trigger a negative spiral. Therefore, macroprudential policy should serve as the first line of defence against excessive debt. In this case, more frequent implementation of macroprudential policy measures limits the risks of development and leads to a positive relationship between the interaction term and economic growth. The development of financial markets has allowed financial institutions to take on higher leverage while having better risk management and tolerance. However, high leverage increases the vulnerabilities of debtors (and thus creditors) to macroeconomic volatility and heightened uncertainty. Restrictive macroprudential policy reduces and diversifies the risks, so the interaction between policy interventions and financial markets development has a positive impact on economic growth. Macroprudential measures weakens the impact of financial development but ensures sustainable growth and mitigates possible crises and their severity.

Dependent variable	*(1a)* **GDP growth**	*(1b)* **GDP per capita growth**	*(1c)* **GVA growth**	*(1d)* **GDP growth**	*(1e)* **GDP per capita growth**	*(1f)* **GVA growth**	*(2a)* **GDP growth**	*(2b)* **GDP per capita growth**	*(2c)* **GVA growth**	*(2d)* **GDP growth**	*(2e)* **GDP per capita growth**	*(2f)* **GVA growth**
Lagged dependent variable	**-0.292**** **(0.127)**	**-0.221*** **(0.123)**	**-0.286***** **(0.088)**	**-0.252*** **(0.131)**	-0.196 (0.121)	**-0.240**** **(0.098)**	**-0.265**** **(0.116)**	**-0.199*** **(0.110)**	**-0.262***** **(0.083)**	**-0.218*** **(0.117)**	-0.162 (0.107)	**-0.201**** **(0.092)**
FDI (markets)	**0.036*** **(0.021)**	0.037 (0.023)	**0.064**** **(0.025)**	0.035 (0.023)	**0.039*** **(0.024)**	**0.059*** **(0.033)**	**0.087***** **(0.012)**	**0.085***** **(0.013)**	**0.100***** **(0.012)**	**0.086***** **(0.013)**	**0.084***** **(0.014)**	**0.095***** **(0.015)**
Macroprudential Policy Index	-0.188 (0.197)	**-0.303**** **(0.145)**	-0.207 (0.205)	-0.022 (0.161)	-0.147 (0.120)	-0.052 (0.173)						
Prudential Policy Index							-0.075 (0.063)	-0.093 (0.061)	0.025 (0.095)	-0.008 (0.061)	-0.036 (0.056)	0.076 (0.083)
FDI_FM × MPI	**0.027**** **(0.013)**	**0.025*** **(0.015)**	**0.015** **(0.013)**	**0.025**** **(0.012)**	**0.023*** **(0.013)**	0.015 (0.015)						
FDI_FM × PPI							**0.048**** **(0.021)**	**0.042**** **(0.021)**	**0.049**** **(0.020)**	**0.050**** **(0.023)**	**0.043*** **(0.023)**	**0.050**** **(0.024)**
Labour productivity	**0.519***** **(0.175)**	**0.534***** **(0.181)**	**0.466**** **(0.194)**	**0.525***** **(0.188)**	**0.530***** **(0.193)**	**0.474**** **(0.210)**	**0.567***** **(0.149)**	**0.584***** **(0.159)**	**0.520***** **(0.169)**	**0.571***** **(0.162)**	**0.581***** **(0.172)**	**0.528***** **(0.182)**
Trade openness	**0.017***** **(0.003)**	0.002 (0.002)	**0.016***** **(0.004)**	**0.018***** **(0.004)**	0.004 (0.003)	**0.017***** **(0.004)**	**0.018***** **(0.003)**	**0.004**** **(0.002)**	**0.018***** **(0.004)**	**0.018***** **(0.003)**	**0.005***** **(0.002)**	**0.017***** **(0.003)**
Inflation	**0.718***** **(0.197)**	**0.572***** **(0.177)**	**0.858***** **(0.246)**	**0.631***** **(0.203)**	**0.488***** **(0.183)**	**0.775***** **(0.247)**	**0.685***** **(0.209)**	**0.538***** **(0.187)**	**0.844***** **(0.268)**	**0.600***** **(0.217)**	**0.459**** **(0.193)**	**0.762***** **(0.275)**
Monetary Conditions Index	**-0.617***** **(0.133)**	**-0.755***** **(0.110)**	**-0.639***** **(0.183)**				**-0.537***** **(0.065)**	**-0.627***** **(0.079)**	**-0.508***** **(0.092)**			
Interbank rates/EURIBOR				**-0.268***** **(0.099)**	**-0.408***** **(0.093)**	**-0.302**** **(0.139)**				**-0.252***** **(0.076)**	**-0.358***** **(0.086)**	**-0.252***** **(0.098)**
Financial crisis dummy	**-2.516***** **(0.686)**	**-2.103***** **(0.599)**	**-2.189***** **(0.468)**	**-2.530***** **(0.697)**	**-2.153***** **(0.615)**	**-2.217***** **(0.491)**	**-2.454***** **(0.636)**	**-2.031***** **(0.550)**	**-2.114***** **(0.438)**	**-2.458***** **(0.642)**	**-2.057***** **(0.561)**	**-2.117***** **(0.452)**
Constant	**1.377*** **(0.751)**	**2.024***** **(0.701)**	1.167 (0.770)	0.342 (0.609)	**1.031*** **(0.619)**	0.172 (0.631)	**0.804**** **(0.324)**	**1.097***** **(0.388)**	0.396 (0.363)	0.259 (0.347)	0.592 (0.404)	-0.099 (0.359)
Observations	204	204	204	216	216	216	204	204	204	216	216	216
AR (2)	0.033	0.019	0.013	0.048	0.027	0.018	0.050	0.023	0.016	0.062	0.029	0.018
Hansen	0.017	0.020	0.016	0.016	0.019	0.016	0.019	0.022	0.021	0.021	0.020	0.026

Table 4.5: Results for the extended specification with FDI_FM × MPP interaction term

Source: own elaboration in STATA

*Note: Driscoll and Kraay (1998) robust standard errors are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.*

4.3.5 Robustness check

In the previous chapters, I use the system-GMM techniques, following Arellano and Bover (1995) and Blundell and Bond (1998) and execute them using "xtabond2" command in Stata (Roodman, 2009). To check for robustness, I compare the estimates with the fixed effects estimates obtained by using "xtreg" command in Stata. The static panel data regression is based on the following equation:

$$\Delta y_{it} = \alpha_i + \alpha_t + \beta \Delta FDI_{it} + \gamma \Delta Controls_{it} + \Delta \varepsilon_{it} \quad (4.4)$$

where i and t represent country and time period indexes and the dependent variable y_{it} is a measure of economic growth. Furthermore, α_i and α_t are country and fixed time effects which include unobserved cross-country heterogeneity as well as unobserved factors that are common across countries but vary over time. The structure of control variables is similar to the system-GMM regression, only the monetary policy indicators enter in their original values (compared to the use of lags in system-GMM regressions). The system-GMM regression is based on (4.3) without any changes.

The results of the robustness check for the baseline specification (**Table 4.6**) confirm that the fixed-effects results are less robust compared to the GMM estimates. The significance of financial development is stronger in the fixed effects models with the MCI as monetary policy stance (columns 1a-1c), while the use of interbank rates/EURIBOR (columns 1d-1f) results in comparable results across the methods. The main differences between the two specifications are in coefficients of monetary policy indicators (fifth and sixth line), because in the static model, I do not employ the lagged variables. Therefore, the static model does not correspond with economic reality, as monetary policy transmission is lagged and this needs to be included in the model specification. For other control variables, the results are consistent, proving that the Nickell bias is marginal in this context. However, the use of static model specification is not possible, because of the Woolridge test results (eleventh line). The p-values for Woolridge test for autocorrelation in panel data are statistically significant, so the null hypothesis on presence of no first-order autocorrelation is rejected.

	(1a)	*(2a)*	*(1b)*	*(2b)*	*(1c)*	*(2c)*	*(1d)*	*(2d)*	*(1e)*	*(2e)*	*(1f)*	*(2f)*
Dependent variable	**GDP growth**		**GDP per capita growth**		**GVA growth**		**GDP growth**		**GDP per capita growth**		**GVA growth**	
Method	**FE**	**GMM**	**FE**	**GMM**	**FE**	**GMM**	**FE**	**GMM**	**FE**	**GMM**	**FE**	**GMM**
Financial development index	**0.088****	**0.134*****	**0.082***	**0.132*****	**0.077***	**0.153*****	**0.063****	**0.132*****	**0.060****	**0.129*****	**0.073****	**0.135*****
	(0.042)	**(0.021)**	**(0.044)**	**(0.022)**	**(0.044)**	**(0.021)**	**(0.029)**	**(0.014)**	**(0.029)**	**(0.014)**	**(0.032)**	**(0.023)**
Labour productivity	**0.533*****	**0.520*****	**0.558*****	**0.542*****	**0.487*****	**0.468****	**0.541*****	**0.605*****	**0.555*****	**0.623*****	**0.499*****	**0.540*****
	(0.066)	**(0.177)**	**(0.068)**	**(0.186)**	**(0.069)**	**(0.197)**	**(0.054)**	**(0.144)**	**(0.055)**	**(0.143)**	**(0.061)**	**(0.205)**
Trade openness	**0.032****	**0.019*****	**0.029***	**0.005****	**0.041****	**0.018*****	**0.019***	**0.019*****	0.014	**0.007****	**0.026****	**0.020*****
	(0.016)	**(0.004)**	**(0.016)**	**(0.002)**	**(0.016)**	**(0.005)**	**(0.010)**	**(0.004)**	(0.010)	**(0.003)**	**(0.012)**	**(0.005)**
Inflation	**0.427*****	**0.684*****	**0.299****	**0.541*****	**0.487*****	**0.825*****	-0.036	**0.291*****	-0.091	**0.250*****	**0.216****	**0.606****
	(0.121)	**(0.208)**	**(0.125)**	**(0.189)**	**(0.127)**	**(0.258)**	(0.063)	**(0.094)**	(0.064)	**(0.083)**	**(0.104)**	**(0.237)**
Monetary Conditions Index	0.013	**-0.496*****	0.026	**-0.575*****	0.087	**-0.518*****						
	(0.119)	**(0.059)**	(0.123)	**(0.073)**	(0.124)	**(0.110)**						
Interbank rate/EURIBOR							0.030	**-0.135*****	0.066	**-0.125*****	**0.321*****	-0.042
							(0.046)	**(0.039)**	(0.046)	**(0.042)**	**(0.090)**	(0.057)
Financial crisis dummy	**-2.646*****	**-2.430*****	**-2.414*****	**-2.004*****	**-2.455*****	**-2.089*****	**-2.734*****	**-2.476*****	**-2.563*****	**-2.234*****	**-2.318*****	**-2.476*****
	(0.326)	**(0.686)**	**(0.337)**	**(0.596)**	**(0.340)**	**(0.458)**	**(0.256)**	**(0.691)**	**(0.259)**	**(0.619)**	**(0.303)**	**(0.561)**
Constant	-0.992	**0.719****	-1.268	**0.974****	**-1.729***	0.458	0.841	**1.034*****	0.513	**0.955*****	-0.754	0.030
	(1.000)	**(0.359)**	(1.034)	**(0.430)**	**(1.043)**	(0.341)	(0.545)	**(0.372)**	(0.551)	**(0.317)**	(0.756)	(0.343)
Observations	204	204	204	204	204	204	381	381	381	381	252	252
R-squared (overall)	0.539		0.412		0.454		0.476		0.435		0.544	
Woolridge	0.002		0.001		0.018		0.000		0.000		0.006	
AR (2)		0.042		0.024		0.016		0.041		0.030		0.053
Hansen		0.024		0.026		0.022		0.009		0.009		0.029

Table 4.6: Robustness check for the baseline specification

Source: own elaboration in STATA

*Note: Standard errors clustered at the country-level (fixed-effect estimations) and Driscoll and Kraay (1998) robust standard errors (GMM estimations) are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.*

4.4 Discussion of the results

My results indicate that there is a positive and significant relationship between financial development and economic growth. Faster development in depth, access and efficiency of financial institutions and markets leads to faster economic growth. When I separate the two aspects, financial institutions development and financial markets development, it can be concluded that the positive finance-growth relationship is driven mainly by improvements in financial markets, as improvements in financial institutions do not have a statistically significant relationship with economic growth. The results are in line with three meta-analyses on the finance-growth relationship from Arestis et al. (2014), Valickova et al. (2015) and Biljsma et al. (2018). Furthermore, they prove the decreasing effect of financial development on economic growth, showing that the studies with pre-crisis estimates are overly optimistic. The outcomes of my research contribute to the research on this topic mainly by employing a composite indicator for financial development, as many previous studies use a single proxy variable or combination of different proxies. I use the composite index and its sub-indices because reliance on one indicator may be misleading, since financial development is a complex phenomenon, so different variables may offer conflicting information. Therefore, the use of composite indicator is favourable, as it provides a broader view of the conditions in the financial sector in the analysed countries. My approach is in line with studies reviewed in this thesis, e. g. on monetary policy (Babecká-Kucharčuková et al., 2016; Frait and Malovaná, 2017), which also work with composite indicators.

The finance-growth relationship remains positive in all specifications of my model. However, the post-crisis regulatory measures of macroprudential nature influence this nexus when they enter the model. The relationship between macroprudential policy and economic growth is twofold and sensitive to the indicator capturing implementation of macroprudential policy instruments. Sensitivity of research outcomes to specific modelling assumptions is confirmed by the meta-analysis of Fidrmuc and Lind (2018). When the focus is on cumulative use of policy actions without considering their effect, macroprudential policy has negative effect on economic growth. This indicates that growing use of macroprudential policy actions, which aim at limiting systemic risk and probability and severity of crises, negatively affects economic growth because the limitations outweigh the benefits of such policy actions. These results are in accordance with Sánchez and Rohn (2016) who employ the same indicator and conclude that more

frequent use of macroprudential policies may be associated with lower economic growth. When the macroprudential policy indicator includes frequency of use together with effects of implemented instruments, the contribution of macroprudential policy to economic growth is positive. The employment of this indicator reflects that macroprudential policy actions limit excessive cumulation of risk, make financial crises less possible and severe, thus ensuring financial stability which is a prerequisite for sustainable growth. These results are in line with Boar et al. (2017) who conclude that more active macroprudential policies are associated with higher growth rates and with Neanidis (2019) who state that regulatory policy rules are beneficial to long-run economic growth. To sum it up, appropriate regulatory measures can be beneficial if their effect is properly assessed. In this regard, macroprudential policy reduces the potential for harm without imposing any costs by ensuring that the financial institutions have more equity to absorb their losses. With the help of macroprudential policy, the risk of crises is limited together with their severity and costs to the society.

The implications of interactions between financial development and macroprudential policy for economic growth show that the role of macroprudential policy outweighs the role of financial development which is in accordance with findings of Bernier and Plouffe (2019). The results of the interactions prove that the role of macroprudential policy measures is twofold. On the one hand, macroprudential policy limits the potential disruptions in financial sector resulting from financial development and dampens impacts of such disruptions to the economy. More active use of macroprudential policy reduces costs and severity of financial crises and ensures financial stability. Therefore, the interaction between financial development and macroprudential policy has positive relationship with economic growth. These findings are in line with those of Agénor et al. (2018) who show that growth may be promoted when prudential policies mitigate financial risks to the economy. On the other hand, tightening nature of macroprudential policy may overly limit the process of financial development, leading the interaction to a negative relationship with economic growth. Macroprudential policy measures slow down the effects of financial development to an extent when their interaction harms economic growth. Therefore, tightening of activities in the financial sector is negatively associated with financial development (the possibility to diversify the risk into other financial activities is limited). Slower financial development affected by macroprudential policy tightening of a preventive nature overly limits excessive credit

and risk, thus slowing down economic growth. These results are in line with the meta-analysis of Fidrmuc and Lind (2018); however, the macroprudential policy indicator which I use captures different policy instruments, while the meta-analysis only focuses on impacts of capital requirements. In the regressions which explore interactions between development of financial institutions, macroprudential policy and economic growth, the interaction of the first two was positive in all cases, indicating that the interaction between growing frequency of use of restrictive macroprudential measures and development of financial institutions leads to faster economic growth.

4.5 Summary of the chapter

In this chapter, I elaborate on the theoretical framework, data and stylised facts and analyse the implications of financial development and macroprudential policy for economic growth in the selected panel of countries.

The first part of the chapter is theoretical, as I explain different approaches to panel data regression, together with methodology and research design I employ. Based on all the presented knowledge, I specify the models – the baseline specification focusing solely on the finance-growth relationship and the extended specifications which add macroprudential policy and the interactions to the model. Furthermore, I summarise and analyse all input data for the models.

The second part reports results of the different model specifications. In these, I analyse the coefficients in terms of sign, size and significance and I elaborate on the economic impacts of the values. Furthermore, I explain how each of the variables entering the model influences economic growth and which transmission channels are used and relate my findings to relevant studies from the past. Among all the models, the most statistically significant and economically correct results are obtained when interbank rate/EURIBOR captures the monetary policy and when the macroprudential policy indicator contains the frequency of use of the instruments together with the effects in their changes.

Third, I conduct a robustness check where I compare the results of GMM estimation for the baseline specification with static fixed-effects regression estimates. As expected, the fixed-effects estimates are less robust compared to the system-GMM ones. Furthermore, the static fixed-effects regression results contain first-order autocorrelation which is detected by performing Woolridge test.

Lastly, I compare my results to the outcomes from the literature. In the discussion, I elaborate on each of the analysed phenomena and their implications for economic growth, both separately and jointly. I prove that my findings of positive finance-growth relationship, with financial markets leading the growth is in line with literature, that the implications of macroprudential policy on economic growth are twofold and that the direction of the relationship between financial development, macroprudential policy and economic growth is sensitive to model specification and choice of variables.

5 Conclusion

The literature on the finance-growth relationship has considerably evolved throughout the years, because financial development remains to be an important condition for economic growth. After the Global Financial Crisis in 2009, there has been a growing need for regulatory practices aiming at preventing the build-ups of risks to limit possibilities, severities and costs of further crises. As a result, macroprudential policy was introduced and has been implemented and its interactions and implications have been analysed, both theoretically and empirically.

My thesis focused on separate and joint implications of financial development and macroprudential policy for economic growth in the European Monetary Union on a sample of 12 countries. The main aim of this thesis was to identify such implications from both theoretical and empirical perspective. The theoretical part provided a framework with definitions and measures of the analysed phenomena, together with a thorough review of existing literature on various aspects of the finance-growth relationship and interactions of financial development, macroprudential policy and economic growth. In the data and stylised facts part, the focus was on the panel of countries, implementation of monetary and macroprudential policy and measures of the analysed phenomena.

In the empirical part, I employed the dynamic panel data regressions with GMM estimator to analyse the finance-growth relationship and the interactions between financial development, macroprudential policy and economic growth in the panel of countries. My results confirmed that there is a positive relationship between financial development and economic growth in the baseline model which excludes macroprudential policy. Among the two-analysed sub-indices of financial institutions and financial markets development respectively, I found that the developments in financial markets are more important for economic growth, as they lead the overall growth contributions. In the models extended by macroprudential policy measures, my results indicated that more frequent use of macroprudential policy measures seems to moderately reduce economic growth. When I used a measure containing the effect of implemented policy measures, the implications for growth are positive, hinting that macroprudential tightening is beneficial for growth. The interactions between financial development and macroprudential policy offset the impact of financial development on growth when

entered separately, but the overall relationship is still positive, as macroprudential policy impacts growth by mitigating possible crises and limiting their costs to the economy.

To sum it up, macroprudential policy enables stable developments in the financial environment which positively contributes to sustainable growth. In a monetary union, country-specific imbalances cannot be offset by the uniform monetary policy and hardly by the institutionally constrained fiscal policy. Therefore, macroprudential policy provides the countries with a set of tools that can be tailored to specific risks on a national level which have smaller implementation lags than other public policies to offset divergences in national financial cycles and promote sustainable growth.

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List of Abbreviations

ACPR	French Prudential Supervisory and Resolution Authority (Autorité de contrôle prudentiel et de résolution)
AMCESFI	Macroprudential Authority Financial Stability Council (Autoridad Macroprudencial Consejo de Estabilidad Financiera)
AMF	French Financial Markets Authority (Autorité des marchés financiers)
ANC	French Accounting Standards Authority (Autorité des normes comptables)
APB	Portuguese Bank Association (Associaçao Portiguesa de Bancos)
APP	asset purchase programme
AR (2)	Arellano-Bond test tests for autocorrelation of the residuals
ATM	automated teller machine
BaFin	Federal Financial Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht)
BASEL I	Basel Capital Accord
BASEL II	capital adequacy framework
BASEL III	capital and liquidity reform package
BCBS	Basel Committee on Banking Supervision
BCL	Central Bank of Luxembourg (Banque Centrale du Luxembourg)
BdE	Central Bank of Spain (Banco de España)
BIS	Bank for International Settlements
CAA	Insurance Commission (Commissariat aux Assurances)
CCYB	countercyclical capital buffer
CdRS	Systemic Risk Committee (Comité du Risque Systémique)
CRD IV	Capital Requirements Directive IV (Directive 2013/36/EU)
CRD V	Capital Requirements Directive V (EU Directive 2019/878)
CRR	Capital Requirements Regulation (Regulation (EU) No 575/2013)
CRR II	Capital Requirements Regulation II (Regulation (EU) 2019/876)
CSSF	Financial Supervisory Authority (Commission de Surveillance du Secteur Financier)
DNB	Central Bank of the Netherlands (De Nederlandsche Bank)
DSTI	debt service-to-income ratio
DTI	debt-to-income ratio
ECB	European Central Bank
EEA	European Economic Area
ESRB	European Systemic Risk Board
EURIBOR	Euro Interbank Offered Rate
FDI	Financial Development Index
FIN-FSA	Financial Supervisory Authority
FISIM	financial intermediation services indirectly measured
FMA	Financial Market Authority
FMSB	Financial Market Stability Board
FSB	Financial Stability Board
FSC	Financial Stability Committee

FTOs	fine-tuning operations
G-SIB	global systemically important bank
G-SIII	global systemically important institution/insurer
GDP	gross domestic product
GMM	generalised method of moments
GMPI	Global Macroprudential Policy Instruments
GVA	gross value added
HCSF	High Council for Financial Stability
HICP	Harmonised Index of Consumer Prices
ILO	International Labour Organisation
IMF	International Monetary Fund
IPU	intermediate parent undertaking
IV	instrument variables
LCR	liquidity coverage ratio
LTD	loan-to-deposit ratio
LTI	loan-to-income ratio
LTROs	longer-term refinancing operations
LTV	loan-to-value ratio
MaPPED	Macroprudential Policies Evaluation Database
MCI	Monetary Conditions Index
MoF	Ministry of Finance
MPI	Macroprudential Policy Index
MROs	main refinancing operations
NBB	National Bank of Belgium
NCB	national central bank
NSFR	net stable funding ratio
O-SIII	other systemically important institution
OECD	Organisation for Economic Co-operation and Development
OeNB	National Bank of Austria (Oesterreichische Nationalbank)
OMTs	Outright Monetary Transactions
PPI	Prudential Policy Index
R&D	research and development
RWA	risk-weighted assets
SMP	Securities Markets Programme
SRB	systemic risk buffer
SSM	Single Supervisory Mechanism
TEU	Treaty on European Union
TFEU	Treaty on the Functioning of the European Union
TLAC	total loss absorbing capacity
TLTROs	targeted longer-term refinancing operations
VLTROs	very long-term refinancing operations
WEF	World Economic Forum
WIIW	The Vienna Institute for International Economic Studies (Wiener Institut für Internationale Wirtschaftsvergleiche)

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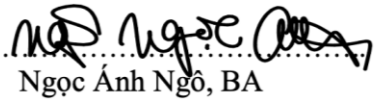

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